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Table of Contents

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Using the Multidimensional Leadership Questionnaire to Analyse the Relationships Between Urban Leadership and the Attributes of Transactional and Transformational Leadership

Abstract

Objectives: To analyse the relationships between urban leadership and the attributes of transactional leadership and transformational leadership.

Research Design & Methods: The analysis was performed using the Multidimensional Leadership Questionnaire from 6th December, 2020, to 7th June, 2021. The surveyed sample comprised mayors of Polish cities, their deputies, and city secretaries (surveyed population: 111; sample size: 48).

Findings: The findings demonstrate a significant link between the leadership behaviours of the mayors and more objective urban performance indicators as perceived by their direct subordinates. Focusing development efforts and activities on those behaviours that most strongly correlate with a wide range of performance indicators, such as idealised influence or contingent reward, may translate into an improved effectiveness of urban authorities. The study also emphasises the importance of maintaining a balance between a variety of leadership styles.

Implications / Recommendations: Building theoretical models to explore the issue of urban leadership will be critical for future research on urban leadership. Equally essential will be the expanded use of psychometric indicators in the context of meta-analyses and theoretical models revealing the links that exist between leader behaviour and various performance metrics.

Contribution / Value Added: The article's added value is in providing evidence that multifaceted leadership, based on transactional and transformational leadership traits, is required to ensure the quality of management of complex and dynamic systems, such as large cities.

Keywords: urban leadership, transactional leadership, transformational leadership, leaders, performance indicators, complex systems

Article classification: empirical article

JEL classification: H1, H4, H7

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Introduction

The aim of this paper is to analyse transactional and transformational leadership and to assess their theoretical and empirical significance in urban leadership research. In a post-modern, rational society, it turns out that the leader, his/her attributes, professed ideals, and favoured leadership styles still hold the key to urban matters and cannot be replaced by rigid management methods. However, the phenomenon in question still requires in-depth reflection, especially of a theoretical nature. The research findings discussed in this article may significantly contribute to the methodological debate on the fascinating phenomenon of urban leadership. The conclusions presented in the paper are based on the findings of the Multidimensional Leadership Questionnaire, which was used to survey mayors, deputy mayors, and city secretaries in Poland (111 in total).

The paper begins with a discussion of the concept of urban leadership, then goes on to highlight its key traits and to review the post-modern conditions that affect its evolution. This is followed by a synthesis of transactional and transformational leadership, in which their basic assumptions are confronted with the logic of urban leadership. The final section addresses the research findings that will serve as the foundation for future theoretical explorations of the concept in question (in this study, the terms urban leadership and public leadership are used interchangeably).

Literature review

The concepts of transactional and transformational leadership, devised by J. M. Burns (1978), have shaped the perceptions of public leadership for many years (Avolio & Bass, 2002; van Wart, 2003; Vogel & Masal, 2015; Jacobsen & Andersen, 2015; Jensen et al., 2019; Baran & Mazur, 2021). What is also noteworthy is that these approaches are conceptually and methodologically grounded in research on political leadership (Hartley, 2018), which is strongly associated with public leadership and urban leadership[1].

Intellectual interest in transactional and transformational leadership theories is accompanied by a growing research interest in urban issues, including the ways in which leadership roles are fulfilled. Cities and civilisations are undergoing disruptive changes, which invalidate the existing rules of the game (Benington, 2011). Remedies for these challenges are sought in a variety of leadership theories, which offer several catalogues of behaviours and tools for managing complexity (Crosby & Bryson, 2005).

The definition of urban leadership used in this article is based on J. Nye's approach, according to which leadership is a social relationship made up of three closely related components: the leader, the followers, and the environment in which particular interactions can occur (Nye 2010). More in-depth considerations on urban leadership require a general summary of its distinguishing features, which include the following:

- a strong professional identity (Grøn, Bro & Andersen, 2019);
- central influence (authority) (Kwok et al., 2018);
- public accountability for the leadership vision pursued (Haus, 2004);
- promoting norms, ideas, and values, and bringing like-minded people together (Freidson, 2001; Brehm & Gates, 2010; Tummers, 2013; Andersen & Pedersen, 2012);

[1] It should be noted that M. Weber is widely regarded as the father of transactional and transformational leadership, which is owing to his definition of three forms of leadership: charismatic, bureaucratic, and traditional. He thus laid the groundwork for these two theories (cf. Weber, 2002).

- focus on collective (public) goals;
- professional knowledge (Andersen & Pedersen, 2012);
- attachment to bureaucratic logic (Ouchi, 1980) or managerial logic (Hood, 1991);
- consideration of the interests of the political environment;
- the irreducibility of challenges.

When focusing on the evolving context of public leadership, J. Hartley considered globalisation[2] to be the source of numerous negative outcomes, such as:

- economic and social inequalities;
- erosion of democracy;
- uncontrolled development of technology;
- low quality of public debate;
- adverse effects of climate change;
- migration;
- adverse changes in the structure of societies;
- unstable economic relations;
- a sense of injustice, anxiety, and mistrust.

Nowadays, city authorities are facing a greater financial burden and responsibility towards their residents than before. With fewer resources at their disposal, they must meet people's increasing expectations in terms of the range and quality of public services to be supplied. Their position is further complicated by increasing networking (transnational neo-pluralism)[3] that transcends hierarchical structures, which calls for increasingly sophisticated urban leadership strategies.

Individual types of leadership are usually presented as separable concepts; however, there is a growing recognition of the relationships that exist between them. The first one involves the reinforcement of transactional leadership by transformational leadership, which leads to increased effectiveness (Bass & Avolio, 1994; Howell & Avolio, 1993; Luke, 1998), whereas the second one views transactional leadership as a subset of transactional leadership (Weihrich et al., 2008; Wright et al., 2008).

The figure above specifies the various needs that the recipients of transactional and transformational leadership may have as well as how the two styles may be used in combination. Transactional leadership, which meets the most basic, unique needs of its followers, is thus placed at the bottom of the hierarchy of needs. Transformational leadership, on the other hand, promotes a particular environment's more advanced goals and desires, which are collaborative in nature and deeply anchored in ethics. The most desirable model located at the top of the hierarchy attempts to simultaneously fulfil the needs, over time transformed into expectations and derived from transactional and transformational leadership. This synthesis is not so much a new leadership style or an ideal solution as a space for utilising local resources and competencies in the most adaptive manner under the prevailing conditions. In the context of urban leadership, the institutional capacity to develop and implement action plans includes both agencies and structures. The third essential element in this interpretive scheme is the context, consisting of quantitatively fluid and dynamically changing variables. In an open social system, the context is viewed as both an opportunity and a threat that stimulates the improvement of urban leadership tools and mechanisms. The model discussed above is distinguished by complexity and modality, which permits variable application

[2] For an extensive analysis of the impact of globalisation on public leadership, see Morse et al., 2007.

[3] This expression implies an above-average complexity and transversality of the system (cf. Cerny, 1990, 2010a, 2010b).

of leadership styles taking into consideration the competencies of the leader and the demands of his/her followers, who serve as the system's dual driving force.

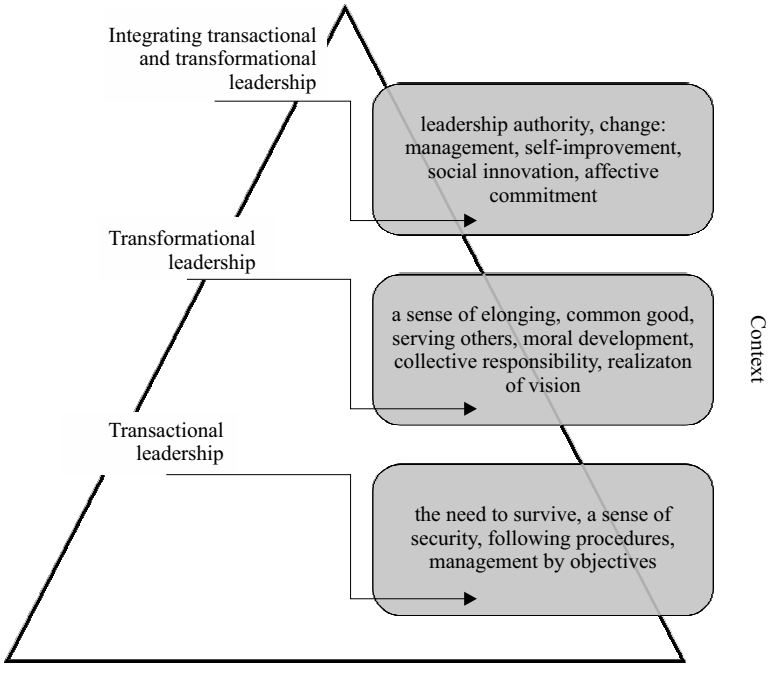

Figure 1. Hierarchy of the needs of the recipients of transactional and transformational leadership
Source: Own elaboration.

Transactional leadership focuses on competent, effective, and efficient management. The incentive system, which is an important part of this style, is exclusively linked to real time and does not take into account strategic thinking about the future.

In practice, transactional leadership leads to:

- attachment to a hierarchy of needs;
- a pursuit of individual interests;
- operating within the boundaries of the existing organisational culture;
- striving for precision;
- creating relationships on the basis of exhaustible replacement;
- making incremental changes to increase efficiency in achieving objectives.

The bureaucratic nature of public administration, characterised by a mechanistic organisational culture, intuitively navigates towards transactional leadership as the most useful one in achieving public tasks. The hierarchical structure of public administration makes this approach an indispensable component of leading a city.

By contrast, transformational leadership[4] aims to inspire the actors gathered around the leader to achieve higher goals (Robbins & Coulter, 2007). The leader's role is to establish an environment

[4] Transformational leadership is often equated with charismatic leadership (see: Peters & Austin, 1985; Tichy & Devanna, 1986; Harvey-Jones, 2003).

where team members may continually develop, expand the range of their needs, and raise their level of awareness. Positive change also includes the release of emotions that leads to the consolidation of efforts to achieve the accepted ideas, values, and tasks. This was aptly captured by W. Bennis and B. Nanus (1985), who described transformational leaders as "social architects" of their organisations. Researchers R. Koch and J. Diox divide transformational leaders into "American heroes" (Western democracies) and leaders stuck in a "servant-partner" relationship[5] (Europe and Great Britain)[6] (Koch & Diox, 2007).

The most important outcomes of applying transactional leadership include:

- increased motivation;
- the realisation of collective interests;
- the reinforcement of moral values;
- the expression of emotional reactions;
- identification with accepted principles of behaviour;
- managing organisational culture change;
- implementing disruptive change to enhance performance in achieving goals.

When considering the attractiveness of the transformational leader in fulfilling this role in a city, it is important to note the positive correlation between this type of leadership and the achievement of desired outcomes in public institutions (Gabris et al., 2000; Wright et al., 2012; Bellé, 2014; Jacobsen & Andersen, 2015; Vogel & Masal, 2015; Baran, 2019).

From the urban leadership perspective, the notion that transactional leadership focuses on solving problems using the potential found within the structure itself is relevant. When faced with difficulties, transformational leadership, on the other hand, draws not only on its immediate surroundings, but also on the expertise of external stakeholders, forging symbiotic relationships with them in order to seek novel solutions. Another significant difference lies in the superior performance of transactional leadership in crisis situations that require poised and structured action. Conversely, transformational leadership gains the upper hand when it is necessary to respond flexibly and take unconventional decisions informed by a multi-level perception of reality.

A comprehensive comparative study of transactional and transformational leadership embedded in contemporary contextual complexity[7] was provided by J. Nye (2008), who described their history, impetus, characteristics, and implications. A key aspect of his distinction is charisma, which, by influencing the course of events, either sustains a functioning system or leads to its significant transformation (Burns, 1978). A good example of this was the civilisational leap triggered by economic development and technological transformation, which was abandoned by apologists of transactional leadership, but was successfully exploited by proactive transformational leadership (*status quo* vs. change) (Nye, 2008; Beauregard, 1995). However, regardless of the motivations of leaders and their achievements, the relationship between them and the actors of change or the actors protecting the existing order, the dynamics of social change, and the needs of citizens drives the spectacular evolution of urban leadership (Stewart, 2006).

A valuable contribution to the issue under consideration has been made more recently by A. M. Hochadel (2018), who looked at the role of public agents by examining the transition from

[5] For more on this subject, see Alimo-Metcalfe & Alban-Metcalfe, 2005, p. 64.

[6] The former tends to be more distanced, whereas the latter has a close relationship with supporters, seeking to understand and meet their needs. The essence of the role performed by the former is to initiate and mobilise. The role of the latter is to keep supporters active, engaged and gratified in a broad sense.

[7] This concept was formulated by R. D. Brunner (1997).

transactional leadership in an administrative-executive perspective to transactional leadership in a legislative-activist perspective. The author's motivation for undertaking this inquiry was her belief that there is a need to combine the potentials derived from locally anchored public leadership with those derived from globalisation processes that transcend national boundaries. J. Johansson (2004) offers a somewhat different perspective that is nonetheless linked to globalisation, contending that transformational leadership in the public sector is a response to the negative repercussions of this particular phenomenon.

Political influence on the form and extent of the application of these two leadership types (Stoker, 1991) tends to be reflected in two approaches. The first one is concerned with the primacy of politics and power strategies in urban governance, whereas the other, in an attempt to move away from the discretionary function of urban leadership, focuses on interactions with other structures at local, national, and global levels (Cerny, 1990, 1997, 2010a, 2010b; Sassen, 2000, 2001; Stoker, 1991). In this sense, the first perspective appears to be closer to transactional leadership, while the second one – to transformational leadership[8].

A different view of transactional vs. transformational leadership is expressed by the Solace (Society of Local Authority Chief Executives), which, while not undermining the cognitive value of these approaches, highlights their negligible adaptability to the dominant context in which cities operate. Urban leadership is heavily dependent on sensitivity to a unique set of dynamically changing local circumstances, in which the resident is the central variable. Therefore, the response to improving the quality of urban life and the prospects for development lies in interactions within the community, which, contrary to the compact statements cited above, are not sufficiently stimulated by transactional or transformational leadership (Solace, 2013; Rigg & Richards, 2006)[9].

Material and methods

The MLQ leadership model

This part of the article discusses the findings of a multi-factor analysis of leadership skills of Polish city mayors. It combines a broader theoretical perspective (outlined in Section 1) with an empirical-analytical perspective in order to offer coherent interpretations of the studied phenomena.

The attempt to capture the full spectrum of leadership behaviours in a multidimensional manner was one of the motivations behind the development of the Full Range Leadership Model, which provided the basis for the Multi-factor Leadership Questionnaire (MLQ) (Antonakis et al., 2003; Bass & Avolio 2002). The MLQ consists of 9 scales that measure three leadership styles: *transformational leadership* (5 scales: Idealised Influence [attributes], Idealised Influence [behaviour], Inspirational Motivation, Intellectual Stimulation, Individual Consideration); *transactional leadership* (2 scales: Contingent Reward, Management by Exception [active]); and *passive/avoidant behaviours* (2 scales: management by exception [passive] and *Laissez-faire*). Moreover, the MLQ also has 3 scales measuring leadership outcomes: Extra Effort, Effectiveness, and Satisfaction with the Leadership. The MLQ has two basic versions: (1) designed to self-assess leadership behaviour (Multi-factor Leadership Questionnaire Self Form [MLQ Self] completed

[8] It is noteworthy that transformational leaders are more likely to be elected when there is growing distrust in central government (cf. also A. M. Hochadel, 2018; Heifetz & Laurie, 2001).

[9] C. Hobbs (2019) suggests replacing transactional and transformational leadership with contextual leadership skills.

by the leader); and (2) designed to evaluate the leader's behaviour (Multi-factor Leadership Questionnaire Rater Form [MLQ Rater Form] completed by subordinates). The choice of the version to use to evaluate leader behaviour is based on theoretical and empirical research assumptions as well as potential organisational interventions. The section that follows examines the leadership styles of Polish city mayors using the Polish edition of the MLQ.

Methodology

The survey was conducted between 6th December, 2020, and 7th June, 2021, among the mayors of the largest cities in Poland (i.e. with populations over 100 000), their deputies, and city secretaries. The surveyed group (111 persons in total) received MLQ 5X-Short questionnaires: the MLQ Self (37 mayors) and the MLQ Rater (37 deputies and 37 city secretaries). Sample test items for each scale are presented in Table 1 below.

Table 1. Sample items used in the MLQ (MLQ Rater)

Style	Scale	Sample item
Transformational leadership	Idealised Influence (attributes)	Working with him/her makes me feel proud
	Idealised Influence (behaviours)	He/she talks about his/her most important values and beliefs
	Inspirational Motivation	Speaks enthusiastically about what should be achieved
	Intellectual Stimulation	Seeks different perspectives when solving problems
	Individual Consideration	Takes the time to teach and develop staff skills
Transactional leadership	Award conditioning	Gives me support in return for my input and commitment
	Management by Exception (active)	Draws attention to irregularities, errors, exceptions and deviations from standards
Passive leadership	Management by Exception (passive)	Does not get involved in a problem until it becomes serious
	Laissez-faire	Avoids involvement when important problems arise
Leadership outcomes	Extra Effort	Makes me do more than expected of myself
	Perceived Effectiveness	Can effectively meet the needs and expectations that arise in the organisation
	Satisfaction with the Leadership	Uses rewarding leadership methods

Source: Own elaboration.

Our analysis takes into account cities where the questionnaire was completed by the mayor, his/her deputy, and the city secretary. A total of 48 questionnaires were returned from 16 participating cities.

The analysis assessed the leadership behaviours of 16 individuals. Of all the mayoral office holders who participated in the study, 15 (94%) were men and only one was a woman. Their mean age was 54 years. The most common educational profile in the sample was the humanities (37%) and technical studies (31%). Only three persons had a degree in economics, and two completed

a university course in an administration-related field. As regards work experience, 44% mentioned the public sector, 37% – business, and 19% – other kinds of experience.

Characteristics of the MLQ

The MLQ proved useful in diagnosing the leadership styles of mayors of Polish cities. In the internal consistency test using Cronbach's alpha (presented in Table 2), several scales proved to be unreliable (Transformational leadership: Idealised Influence [attributes] and Transformational leadership: Individual Consideration, Management by Exception [passive]), but most others achieved acceptable or satisfactory scores. However, in order to maintain the integrity of the tool and given that the MLQ was found highly reliable by a number of independent studies using larger international samples (Tejeda et al., 2001), all the subsidiary variables were included in the study.

Table 2. Reliability indices of the scales used in the study

MLQ scale	Cronbach's alpha	Number of test items
Transformational: Idealised Influence (attributes)	0.34	4
Transformational: Idealised Influence (behaviours)	0.57	4
Transformational: Inspirational Motivation	0.72	4
Transformational: Intellectual Stimulation	0.60	4
Transformational: Individual Consideration	0.51	4
Transactional: Contingent Reward	0.59	4
Transactional: Management by Exception (active)	0.71	4
Passive: Management by Exception (passive)	0.30	4
Passive: *Laissez-faire*	0.60	4
Extra Effort	0.75	3
Perceived Effectiveness	0.58	4
Satisfaction with the Leadership	0.80	2

Source: Own elaboration.

Furthermore, the intercorrelation analysis between the several aspects of the MLQ confirms its utility in the study of local government leadership. The correlations between the scales, as shown in Table 3, follow the predicted direction: there is a negative correlation between passive leadership scales (Management by Exception [passive] and *Laissez-faire*) and most of the scales of transformational and transactional leadership. At the same time, the other leadership scales, while correlated, exhibit significant independence.

One of the most important and interesting issues in this study is the degree of concordance in the assessment of leadership behaviours between the person occupying the mayoral position and his/her deputies and secretaries, as this determines the validity of the assessment and whether our discussion of leadership styles should include self-assessment or external assessment only.

Kendall's W statistic was used to assess the concordance of responses on leadership styles between the mayor and his/her deputies, and between the deputies themselves. It takes values from 0 to 1, where 0 represents a complete disagreement in the assessment, and 1 – a complete

Table 3. Intercorrelation coefficients between MLQ leadership scales (Pearson's r). Shading indicates statistically significant coefficients ($p < 0{,}01$)[10]

	Idealised Influence (attributes)	**Idealised Influence (behaviours)**	**Inspirational Motivation**	**Intellectual Stimulation**	**Individual Consideration**	**Award conditioning**	**Management by Exception (active)**	**Management by Exception (passive)**	***Laissez-faire***
Idealised Influence (attributes)	1.00	0.42	0.37	–0.14	–0.12	–0.13	–0.03	–0.32	0.11
Idealised Influence (behaviours)	0.42	1.00	0.41	0.64	0.22	0.34	0.25	–0.58	0.01
Inspirational Motivation	0.37	0.41	1.00	0.42	0.00	0.26	0.42	–0.56	–0.13
Intellectual Stimulation	–0.14	0.64	0.42	1.00	0.27	0.70	0.61	–0.34	0.01
Individual Consideration	–0.12	0.22	0.00	0.27	1.00	0.29	–0.19	0.00	–0.15
Award conditioning	–0.13	0.34	0.26	0.70	0.29	1.00	0.67	–0.18	–0.20
Management by Exception (active)	–0.03	0.25	0.42	0.61	–0.19	0.67	1.00	–0.20	0.29
Management by Exception (passive)	–0.32	–0.58	–0.56	–0.34	0.00	–0.18	–0.20	1.00	0.00
Laissez-faire	0.11	0.01	–0.13	0.01	–0.15	–0.20	0.29	0.00	1.00

Source: Own elaboration.

[10] Since the study is based on population-wide surveys, statistical significance measures should not be evaluated using inferential statistics; rather, they should only be used to identify the coefficients that need more attention.

agreement between the respondents. This was critical in deciding how to analyse the mayors' leadership styles: if the mayors' and deputies' assessments were equivalent, the MLQ scales could be calculated based on their own individual opinions; if not, more confidence would need to be placed in the external assessment results.

Indeed, the mean values of Kendall's W for the leadership behaviours as assessed by the deputies and secretaries turned out to be significantly higher than when assessed by the three interviewees from each municipal office (0.53 vs. 0.74). This provided an additional argument (i.e. apart from the theoretical one) in favour of assessing the leadership style of mayors solely on the basis of the external evaluation – the findings are presented in the following section.

Results and discussion

In order to explore the relationship between the leaders' behaviours and performance indicators as perceived by their subordinates, a simple analysis of correlation coefficients was conducted (see Table 4).

Table 4. Correlation coefficients between the MLQ leadership scales and three performance measures. Shading indicates statistically significant coefficients ($p<0,01$)[11]

MLQ scale	Extra Effort	Perceived Effectiveness	Satisfaction with the Leadership
Idealised Influence (attributes)	0.28	0.27	0.21
Idealised Influence (behaviours)	0.69	0.47	0.38
Inspirational Motivation	0.39	0.24	0.21
Intellectual Stimulation	0.72	0.41	0.54
Individual Consideration	0.08	0.47	0.27
Award conditioning	0.61	0.49	0.67
Management by Exception (active)	0.54	0.05	0.21
Management by Exception (passive)	–0.21	–0.17	0.03
Passive: *Laissez-faire*	0.08	–0.27	–0.32

Source: Own elaboration.

Table 4 above reveals an interesting pattern. First, none of the correlation coefficients between leadership scales and perceived leader effectiveness exceeded 0,5[12]. Second, contrary to frequent claims – apart from passive leadership, which is universally considered to be neutral or negative in terms of performance – it is difficult to unequivocally indicate the best leadership style. Thus, both transformational (Idealised Influence [behaviour], Intellectual Stimulation) and transactional (Contingent Reward, Management by Exception [active]) leadership scales correlate with Extra Effort, which is generally believed to be one of the most important aspects of effectiveness in the leadership model used in the study. The situation is similar for satisfaction with leadership,

[11] See the footnote above.

[12] The correlation coefficients provided in this chapter should be approached with caution due to the common method bias, or the potential overestimation of correlation between variables when measuring dependent and independent variables using the same tool.

which exhibits a strong correlation for both Intellectual Stimulation (transformational behaviours) and Active management by exception (transactional behaviours).

A preliminary look at the findings presented in Table 4 seems to support both those who argue that transformational as well as transactional leadership elements are necessary for effective leadership (Judge & Piccolo, 2004), and the advocates of ambidextrous leadership. According to the latter idea (Zacher & Rosing, 2015), leaders who rely on styles aimed at structuring (such as transactional leadership) and inspiring creativity (such as transformational leadership) make their teams and organisations more effective, especially in terms of innovation and the capacity to develop novel solutions.

It is also interesting to see what the analysis of correlation coefficients reveals regarding the variables that are unrelated to leadership performance items. It turns out, for example, that Individual Consideration is unrelated to Extra Effort and only marginally related to Satisfaction with the Leadership. This may be due to the characteristics of the group that evaluated the mayors – the deputies and city secretaries work closely with their superiors; hence, it is possible that there was little variance in the results in this respect.

Based on the collected data, is it thus possible to accurately predict the performance of the mayor as perceived by his/her subordinates? To further explore the relationship between leadership behaviours and effectiveness, two stepwise linear regression analyses were conducted for the dependent variables identified in the correlation table analysis as potentially related to the types of leadership behaviours diagnosed by the MLQ.

The regression analysis for the dependent variable Satisfaction with the Leadership produced a model explaining approximately 40% of the variance in the dependent variable with the presence of only one independent variable, namely Contingent Reward (the other coefficients did not significantly improve the quality of the model and were therefore not included). The beta coefficient for this model was 0.67 and was the same as Pearson's r correlation coefficient. The situation was different for the model with Extra Effort as the dependent variable. The regression analysis produced a model that explains more than 60% of the variance in the dependent variable by including two independent variables related to transformational leadership: Intellectual Stimulation and Idealised Influence. Details of the model are presented in Table 5.

Table 5. Linear regression model for Extra Effort as the dependent variable

Model parameters	B	SE	Beta	T	Significance
(Constant)	–0.163	0.685		–0.238	0.815
Transformational: Intellectual Stimulation	0.73	0.151	0.778	4.841	< 0.001
Transformational: Idealised Influence (attributes)	0.354	0.146	0.39	2.427	0.031
Dependent variable: Extra Effort Adjusted R^2: 0,62					

Source: Own elaboration.

The results suggest that Intellectual Stimulation and Idealised Influence have an independent significant impact on Extra Effort on the part of subordinates. Beyond these two variables, behaviours associated with other scales do not significantly explain performance in this area.

Leadership behaviour as a predictor of local government performance

One of the most significant challenges associated with the perceived correlations in the area of leadership in the public sector discussed above is the so-called common method bias, i.e. the risk of identifying correlations that arise not from the actual performance of individual aspects of leadership styles, but from using the same tool to measure the dependent and independent variables. Furthermore, in both public and academic debate, objective indicators of leadership performance rather than the employees' subjective opinions are of special relevance in terms of their implications for local government actions.

To that end, we analysed the correlation between various leadership behaviours and the key outcomes of local government initiatives. We focused on two factors that appear to be particularly strongly related to leadership behaviour: citizen involvement in political life (measured as election turnout) and the accomplishment of goals pertaining to creating sustainable cities (Shmelev & Shmeleva, 2009; measured as the length of bus lanes per 100 000 residents; the number of kindergarten places per 100 000 residents; and the share of green space in urban areas). Table 6 below summarises the findings of the regression analysis using the input technique for the six models, which included all behaviour categories assessed by the MLQ and budget expenditure per resident (controlled variable) as independent variables.

Table 6. Summary of basic parameters of linear regression models for selected dependent variables

Dependent variable Parameters of the model	**Length of bus lanes per 100K residents**	**Number of kindergarten places per 100K residents**	**Share of parks, greenery, and residential green areas in total city area**	**Turnout in the 2019 Senate elections**	**Turnout in the 2019 parliamentary elections**	**Turnout in the 2020 mayoral election**
Transformational: Idealised Influence (attributes)	–1.01	–0.60	–0.53	–0.15	–0.16	–0.19
Transformational: Idealised Influence (behaviours)	1.52	0.76	1.33	0.96	0.97	0.99
Transformational: Inspirational Motivation	0.55	0.31	0.62	–0.14	–0.14	0.08
Transformational: Intellectual Stimulation	–1.74	–1.56	–1.10	–0.32	–0.33	–0.45
Transformational: Individual Consideration	0.43	0.14	0.03	–0.20	–0.20	–0.31
Transactional: Award conditioning	–0.39	–0.13	0.19	–0.38	–0.38	–0.11
Transactional: Management by Exception (active)	1.13	0.79	0.03	0.30	0.30	0.04
Passive: Management by Exception (passive)	0.57	–0.10	0.30	0.69	0.69	0.79
Passive: *Laissez-faire*	–0.48	–0.39	–0.23	–0.50	–0.50	–0.18
Total budget expenditure	0.27	0.81	0.29	0.27	0.27	0.29
Adjusted R2	**0.70**	**0.74**	**0.40**	**0.60**	**0.61**	**0.52**
Model significance	**0.06**	**0.04**	**0.23**	**0.10**	**0.10**	**0.15**

Shading: green – statistical significance $p < 0.05$; yellow – statistical significance $p < 0{,}10$[13].

Source: Own elaboration.

[13] See the footnote above.

An interesting picture emerges from the analysis of these regression models. The only type of behaviour that positively predicts all the outcomes of local government activities is Idealised Influence manifested in behaviours. At the same time, in the case of urban sustainability indicators, behaviours related to Intellectual Stimulation and perceived characteristics of Idealised Influence have a negative impact, whereas those related to Management by Exception (active; especially in the case of the variable length of cycle paths per 100 000 residents) have a positive impact. In the case of variables related to voter turnout, an extra positive influence can be observed in the case of Management by Exception (passive). All these relationships were controlled for the key variable of per capita budget expenditure.

How to interpret these patterns? Undoubtedly, Idealised Influence comes closest to the traditional definitions of charisma, so once again we find that charismatic leaders are capable of achieving very tangible outcomes beyond subjective performance measures (Antonakis & Day, 2017). What is somewhat surprising in this light is the negative correlation between Idealised Influence (attributes) and urban sustainability indicators. Also noteworthy is the data that suggests that the passive attitude of mayors (Management by Exception) is offset by increased voter participation.

Conclusion

The issue of urban leadership is becoming increasingly important at least for two reasons. The first one has to do with its practical relevance to the quality of management of large cities, which are complex, comprehensive, and adaptive systems. In a post-modern, rational society saturated with formal institutions and advanced procedures, it turns out that the leader, his/her attributes, professed ideals, and favoured leadership styles still hold the key to urban matters and cannot be replaced by rigid management methods. The third reason stems from the relatively superficial reflection on urban leadership among leadership scholars in recent decades. The situation began to change dramatically when researchers became aware of the importance of this issue for understanding and conceptualising a range of approaches to urban management. Along with this, both the number of studies and publications devoted to this issue began to increase. However, the phenomenon in question still requires in-depth reflection, especially of a theoretical nature.

The MLQ used to prepare this paper proved to be useful. Its psychometric indices demonstrated strong adherence to theoretical and methodological assumptions. Furthermore, the study's findings tying specific leadership characteristics to leader effectiveness are consistent with meta-analyses and models illustrating the relationship between leader behaviours and validated performance indicators.

Particularly interesting findings from this application of the MLQ include the correlation between the leadership behaviours of mayors and their performance as perceived by their subordinates and captured by objective city performance indices. These insights are worth exploring in more detail.

Devising a typology of this phenomenon and developing theoretical models to explain it should be a priority in future studies on urban leadership. Last but not least, there is a good case for making more extensive use of psychometric indicators to study leadership scales in relation to leader effectiveness in the context of meta-analyses and theoretical models revealing associations between leader behaviours and performance indicators.

A number of observations support the use of the MLQ for studying leadership in local government. Firstly, the appropriate psychometric indicators, including the reliability of the scales

and the intercorrelations between the dimensions measured by the MLQ, are mostly consistent with the theoretical and methodological assumptions. Secondly, the study's findings that tie specific leadership characteristics to leader performance are consistent with meta-analyses and theoretical models demonstrating correlations between leader behaviours and numerous performance measures. And, thirdly, the wealth of practical suggestions that can be obtained from the application of the tool for the study of leadership in local government units cannot be overstated.

What pragmatic conclusions can be drawn from the analyses conducted in this chapter? It turns out that there is a significant correlation between the leadership behaviour of mayors, their evaluation by subordinates, and more objective urban performance indicators. Focusing development efforts and activities on behaviours that are most visibly linked to a wide range of performance measures, such as Idealised Influence or Contingent Reward, may translate into an improved effectiveness of municipal offices. The study also makes a compelling case for maintaining a balance between leadership behaviours that represent a variety of styles. In terms of the future research on leaders in local government units, it may be useful to explore which dependent variables other than those reported in this paper correlate with objective urban performance indicators.

The research findings discussed in this article may significantly contribute to the methodological debate on the fascinating phenomenon of urban leadership. By improving the quality of research in this area, it may serve as the foundation for the development of more theoretically-advanced exploratory models.

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Health Security as a Global Public Good in the Conditions of the Revolution 4.0

Abstract

Objectives: Although the concept of health security is becoming accepted in public-health-related literature and practice, there is no full agreement on the scope and content. The aim of this paper is to draw attention to the definition of health security and its role within the Revolution 4.0.

Research Design & Methods: This is a theoretical article and as such addresses a problematic situation concerning missing standards in health security and the Revolution 4.0.

Findings: The WHO (2018) has stated unequivocally that 'functioning health systems are the bedrock of health security'. The authors attempt to prove that health security in the conditions of the Revolution 4.0 needs to be defined more precisely and has to be implemented as a global public good nationwide with accepted minimal standards.

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Implications / Recommendations: Health security belongs to the sphere equally important to that of the Revolution 4.0. A concept of Health Security that is not widely accepted and implemented creates a problematic mélange for employees as well as for industrial development. These features will be considered.

Contribution / Value Added: This paper tries to underline the relative shortage of common agreements on health within the Revolution 4.0.

Keywords: Revolution 4.0, health security, mental and physical health

Article classification: conceptual paper

JEL classification: Y

Introduction

In 1948, Norbert Wiener recounted that the origin of ideas in his book on Cybernetics was a ten-year-long series of meetings at the Harvard Medical School, where medical scientists and physicians discussed scientific methods with mathematicians, physicists, and engineers. He detailed the interdisciplinary nature of his approach as well as his early thoughts on the features and design principles of future digital calculating machines. Nowadays, we are on the edge of the Fourth Digital Revolution, also referred to as the Revolution 4.0. Therefore, the link between health and the digital environment is becoming more and more important, but it is very often disregarded in terms of its importance.

In recent years, the authors of this article have been very much concerned with health and working conditions. We had conducted several empirical studies on this issue alone (Titov et al., 2022; Titov et al., 2020, Seyfried et al., 2014, Rabe et al., 2012a, 2012b). These studies were mostly carried out in the context of the Third Industrial Revolution. We are now in the fourth expansion phase of the industrial evolution and health issues in this regard are becoming more and more important. The concept of health security is becoming increasingly accepted in public health literature and practice. However, there is no full agreement on its scope and content.

The link between security and health is not a discovery. According to Augustynowicz et al. (2022), despite the widespread recognition of the social importance of health security, there is no single common definition of this concept. The aim of this paper is to draw attention to the definition of health security and its impact within the Revolution 4.0. Therefore, the authors would like to draw attention to this topic from a more theoretical point of view regarding the more problematic situation of missing standards within health security and the Revolution 4.0.

Health security – an ambiguous concept

As is very well-known, local public good benefits all members of a local community and can possibly include the citizens of more than one country. Furthermore, an international public good benefits more than one country. Global and regional public goods are both international public goods. However, some international public goods are neither regional nor global. According to the Encyclopedia of Health Economics (Culyer, 2014), the global public good concept is an extension of the economic tradition of classifying goods and services according to where they stand along two axes – one measuring rivalry in consumption, while the other measuring excludability. Global public good benefits all countries and, therefore, all persons. Public goods theory purports to show why goods with rigorously defined characteristics of publicness cannot be produced efficiently by the private sector of the economy, creating a market failure which implies a role for government in the production of those goods for which the market fails. Technically, in their purest form, public goods are those that share two qualities – non-excludability and non-rivalry, in economists' jargon. This means, respectively, that when provided to one party, the public good is available to all, and consumption of the public good by one party does not reduce the amount available for others to consume. Traditional examples of national public goods include traffic control systems and national security – goods that benefit all citizens and national private actors, but none that any of the latter could afford to supply under their own initiative.

The health sector is one of the sectors that is the most exposed to technological evolution, so it is being impacted by digitisation, revolutionising the way healthcare is provided, from the interaction

between patients and caregivers to governments and stakeholders (Schwab, 2017). According to Jagme et al. (2020), the Fourth Industrial Revolution is changing the way in which health is understood, transforming methods of treatment and diagnosis, as well as the relationship between health professionals and patients, altering the management and organisation of health systems.

Within the health sector, mental health plays an important role. Regarding mental health since the end of 2013, the Occupational Health and Safety Act has explicitly required that mental stress must be considered in risk assessments (da Silva et al., 2019). This means that all companies and organisations must also identify those hazards for their employees that result from mental stress at work. In occupational sciences, "mental stress" is understood to mean all influences that come from outside and have a mental effect on people at work. It is, therefore, about the demands of the work or the work activity and the working environment.

William Aldis (2008) underlined that ambiguity and confusion surround the concept of 'health security'. According to Aldis, this has caused damage to international relationships and is likely to lead to more serious problems in the future. For Aldin and many others, the global public health community must work towards a common understanding of the concept, starting with acceptance of the fact that there is a problem. As Aldis pointed out, reaching a consensus on what is meant by 'health security' and 'global public health security' will not be easy; hidden national security agendas will have to be brought out into the open. An uncritical insertion of military and foreign policy (political) interests into the arena of global public health is problematic. Much of the literature makes simplistic assumptions about natural harmony between 'health security', 'global public health security', national security, and foreign policy, as Aldis already underlined in 2008.

In the light of this discussion, Feldbaum et al. already in 2006 gave a more general idea of health security, which could be useful for a more practical point of view:

> *Global health is a humanitarian endeavour that seeks to improve the world's health including the most vulnerable peoples, while national security works to protect the interests of people within a given state … While there is potential to expand global health activities through partnership with the security and foreign policy communities, treating global health issues as national security threats may focus attention disproportionately on countries or diseases which pose security threats to wealthy nations, rather than on the greatest threats to global health. The global health community should carefully scrutinise areas where global health and national security interests overlap* (p. 196).

Ravi et al. (2019) synthesised various foundational principles for measuring global health security. Their review broadly affirmed that when it comes to the conceptual challenges associated with measuring global health security, several practical barriers continue to pose technical challenges. Even with a strong theoretical foundation, measurement efforts might still be hindered by limited data availability. Many of the metrics employed in other tools – both qualitative and quantitative – are not regularly or systematically collected in a standardised manner. Ravi et al. (2019) stated that, although alternative metrics could support more conceptually sound methods of measurement, poor data availability would still preclude their adoption and meaningful use.

Nevertheless, in 2020, Stoeva pointed out that there was no consensus among analysts about the specific parameters of health security. According to Stoeva, this inhibits comparative evaluation and critique, and affects the consistency of advice for policymakers. She claims that a broader conceptualisation of health security could transform the politics of health security, thus improving health outcomes beyond acute crises and thereby contributing to broader debated within security studies.

According to the last release of the WHO, global public health security is defined as the activities required, both proactive and reactive, to minimise the danger and impact of acute public health events that endanger people's health across geographical regions and international boundaries. Population growth, rapid urbanisation, environmental degradation, and the misuse of antimicrobials are disrupting the equilibrium of the microbial world. New diseases, such as COVID-19, are emerging at unprecedented rates, disrupting people's health and causing negative social and economic impacts. Billions of passengers travel by aeroplanes each year, increasing the likelihood for a rapid international transmission and spread of infectious agents and their vectors (WHO, 2022).

However, within the framework of systematic occupational safety and health action, the risk assessment process should be reviewed from time to time and improved if necessary. The aim of risk assessment is to identify potential health hazards at work as early as possible and to avoid or reduce them by taking appropriate protective measures. How risk assessments are to be carried out is not prescribed by law.

However, the future will be within a more digital construction of cities and environment. They will be called within the UN nomenclature `Smart Cities`.

Revolution 4.0

Since the 1960s, companies have integrated and made increasingly greater use of information technologies. Desktop PCs, the use of office IT, and the first computer-based automation have revolutionised industry. For the development of the Revolution 4.0, the central technology is not the computer, but the Internet (Colombo et al., 2014).

With global networking across companies and country borders, the process of digitalising production integrates new technologies of higher quality: the Internet of Things, machine-to-machine communication and production facilities that are becoming increasingly intelligent and heralding in a new era, namely the Fourth Industrial Revolution. People, machines, and products are being directly networked with each other (Schwab, 2017).

Typical examples include remote diagnostic systems, automated transport trolleys, or cloud-based monitoring of the condition of machinery. However, there are also projects that present more integrated solutions and map an overall concept for the smart factory. However, current examples show that the Industry 4.0 is still very often located in an area of research and development (Lim, 2019).

The term 4.0 should describe the new economic miracle, i.e. digital transformation. If one counts the frequency of these buzzwords in business and in technology media, one could almost get the impression that all of these concepts have already been realised. However, companies are only at the beginning of a development that will determine the next ten years across all sectors (Orsolin et al., 2022).

The number '4.0' is generally intended to express the goal of ushering in the Fourth Industrial Revolution:

- The First Industrial Revolution consisted of mechanisation using water and steam power.
- The Second Industrial Revolution was characterised by mass production with the help of assembly lines and electrical energy.
- The Third Industrial Revolution, or digital revolution, is marked by the use of electronics and IT (especially programmable logic controllers and CNC machines) to automate production.
- The number '4.0' is used to describe the process of automation within digital networks.

Implementing the Industry 4.0

According to Castro et al. (2020), an effective and efficient implementation of disruptive technologies requires global interaction between governments, health professionals, stakeholders, and society, which is essential in ensuring that such changes are made possible. Currently, the effects of certain advances remain largely undefined and unaddressed while many conversations have taken place in a somewhat siloed fashion. Implementing the Industry 4.0 is, therefore, a complex endeavour involving different players. Uniform norms and standards for different industrial sectors, IT security, and data protection all play a more central role than the legal framework, the change in education and work, the development of new business models, and the necessary research. How the global, digital ecosystems of the future can be shaped is stated, for example, within the 2030 mission statement for the Industry 4.0, which emphasises sovereignty, interoperability, and sustainability as a central topic (*BMWi*, 2019).

However, there is still a highly controversial assessment regarding the descriptions on the subject of health. A chain of ambiguities is responsible for this. For example, Popov et al. (2022) state that the Industry 4.0 in healthcare uses a wide range of modern technologies including digitisation, artificial intelligence, user response data (ergonomics), human psychology, the Internet of Things, machine learning, big data mining, and augmented reality. According to these authors, the healthcare industry is undergoing a paradigm shift owing to the Industry 4.0, which provides better user comfort through proactive intervention in the early detection and treatment of various diseases. The sector now seems ready to make its next move towards the Industry 5.0, but certain aspects need further consideration. Dupalga (2022) states that the technologies attributed to Health 4.0 are frequently perceived as the tools supporting patient empowerment. In his own literature review, the author revealed that – in addition to web-based applications – personal health records, remote monitoring, and electronic patient-physician communication are all perceived as keys to enhancing patient empowerment. Participation in online patient communities is also recognised as an enabling solution.

Smart Cities, blockchain[1] and health security within the Revolution 4.0

Blockchain technology (BCT), which emerged during the last decade, has gained a great deal of interest in the healthcare sector (Sharma et al., 2022). BCT was designed to revolutionise the management of smart cities with Blockchain4Cities. The technology, while initially focused on financial services, holds great promise in healthcare. According to Saeed et al. (2022), BCT is being applied in designing novel and advanced interventions to enrich the current protocol of managing, distributing, and processing clinical records and personal medical information. The

[1] A *block* is a list of transactions recorded into a ledger over a given period. The size, period as well as the triggering event for blocks is different for every blockchain. A transaction can be seen as recorded data. Assigning a value to it (such as what happens in a financial transaction) is used to interpret what that data means. A *chain* is a hash that links one block to another, mathematically "chaining" them together. The hash in a blockchain is created from the data that was in the previous block. The hash is a fingerprint of this data and locks blocks in order and time. A *network* is composed of "full nodes." Nodes can be seen as computers running an algorithm that is securing the network. Each node contains a complete record of all the transactions that were ever recorded in that blockchain. *A blockchain* is a decentralised, distributed, and often public digital ledger consisting of records called blocks that are used to record transactions across many computers so that any involved block cannot be altered retroactively, without the alteration of all subsequent blocks.

growing digitisation of medical care has advanced the acknowledgment of issues about secure storage, the accessing of patients' medical records, ownership, and associated medical data. Blockchain is recommended as a method of addressing critical issues faced in healthcare, such as the protected sharing of health records and adherence to data privacy laws (Saeed et al., 2022).

Qui et al. (2018) have recently stated that the integration of healthcare and smart cities has led to the utilisation of information and technology in health and medical practices around the world. According to Qui et al., this integration has improved the life and health quality of residents in smart cities, though they also point out that the integration has also exposed the healthcare industry to security challenges, which include patients' private health information as well as the security of mobile health users in the vicinity. The use of Blockchain (see Qui et al., 2018) is a promising technology, which will enable healthcare to counter security challenges in smart cities. Blockchain technology facilitates a safe and secure storage of patient information within the healthcare system.

In the year 2020, there was a ratio of approximately six intelligent devices/things for every human on the planet. In a world of digital business, individuals and IT leaders will need to orchestrate these new devices, new data streams, and new experiences in order to create value. But what principles will these IT leaders apply? How will they deal in their approach to the issue of health security?

Tim Berners-Lee, one of the founders of the World Wide Web, diagnosed that those digital systems are on an edge. This is because of:

- the accelerated monopolisation of data and services;
- a complete transparency of people (not only direct users) while the procedures of companies remain secret;
- fuelling social polarisation in social networks via filter bubbles;
- increased surveillance by governments;
- pseudo-neutrality by delegation of decision-making processes to algorithms, etc.

Despite technology advancements having significant benefits in our lives, the often-overlooked consequences are scary.

We now almost always need to have something electronic in our hands – a technological device that connects us to the Internet. We are bypassing the real world and spending an unprecedented amount of time socialising, working, and thinking with computers.

People are no longer interfacing with people; instead, they rely primarily on technology for knowledge. With less human-to-human interaction, we stagnate our social skills. It also removes open-ended conversations with others, even though they lead to our most creative moments.

Social inclusion is incredibly important to us – just look at the immense popularity of social networking sites. We are constantly focused on what others think and we post pictures not for ourselves, but for others to enjoy. When we spend too much time attempting to please others, we lose track of what we actually want or like. Think about how different our children will be to our grandparents' generation. Children now play with iPads even before they can talk. What impact will this have on the societies to come?

The United Nations International Telecommunication Union (UN ITU) deals with the assessment and measurement of the environmental efficiency of AI and emerging technologies (Alessie et al., 2019; Guo et al., 2020; ITU, 2021). A smart and sustainable city is considered as an innovative city that uses information and communication technologies (ICTs) and other means to improve the quality of life, the efficiency of urban operations, as well as services and

competitiveness while at the same time ensuring that it meets the needs of present and future generations with respect to economic, social, environmental, and cultural aspects (Recommendation ITU-T Y.4900).

Blockchain is an open and shared distributed ledger technology (DLT), which can record transactions between two parties efficiently, permanently, and in a verifiable way. It consists of a shared digital data storage, replicated and synchronised across multiple devices in a network. The main objective of DLT is to establish trust, accountability, and transparency, with no reliance on a single source of authority or on environments where there is a lack of trust between actors. It also promotes decentralisation and data integrity (ITU Report 03/2021 – Guidelines on Energy Efficient Blockchain Systems Assessment and Measurement of the Environmental Efficiency of AI and Emerging Technologies Working Group Deliverable).

The connection between energy and health can be hard to grasp at first glance. Nevertheless, the negative externalities resulting from the consumption of fossil fuels can be clearly identified. In January 2019, the World Health Organization (WHO) named climate change and air pollution as two of the greatest challenges to human health. Energy is now recognised as a foundation for well-being, while recent work has documented the link between access to energy services and health. For example, Mayer et al. (2019) discovered that concerns over energy security reduce subjective well-being, suggesting another avenue through which energy relates to human health. Millions of people rely on electricity to power critical medical equipment. This medically-vulnerable population is at risk of being left without access to critical medical equipment in the event of a power outage. Therefore, energy efficiency is a crucial issue for today and for future city sustainability, especially due to the growing emergence of smart cities (SC) and that of cutting-edge technologies. Some emerging technologies, for instance, including blockchain and its role in cryptocurrency and contracting, may not take sustainability into consideration during their development. These technologies often require a huge amount of energy, leaving behind significant environmental footprints. It is important to understand how to reduce the environmental impact of these technologies, because it will contribute to the well-being of the market economy as well as to the quality of life of citizens and the users of these technologies (ITU, 2019). In this regard, the definition of blockchain energy requirements and of the means that can enhance blockchain energy efficiency would be useful. Thus, this work aims to define the blockchain's energy efficiency model.

Up until now, no issues regarding health security have been found (Giacomuzzi, 2020)[2]. A disturbing survey recently quoted that the average person in the USA now spends around 5 hours per day on mobile devices. Think of all the life that escapes us? We need to incorporate habitual phone-free moments so that we do not allow life to escape us. At any red light or even whilst driving, we are more inclined than ever before to check our mobile phones. We have come to a point where we would place our tech obsession above our health and the health of others.

"*We cannot outsource the moral responsibility of our technologies to third parties*" (Google employees in an open letter to CEO Sundar Pichai). *Our task is not only to rein in the downsides of information and communication technologies, but to encourage human-centred innovation*" (Vienna Manifesto on Digital Humanism). Therefore, the digital humanism approach states that we must go back to the centre of technological developments and making people the benchmark

[2] Talk at the UN ITU online-conference December 2020: Digital humanism and human behaviour in businesses.

and rule for digitalisation processes (Carassai, 2022). Humanity needs to realise that every single human being is part of the humanitarian and ecological crisis (Malisova et al., 2022). The emerging digital world requires human-centric digital leadership[3]. This perspective is driven by the belief that technology is valuable when it allows people to spend less time on mundane, repetitive, and inefficient tasks. Businesses should seek to understand how our shared humanity can define the systems they create and control. Doing so not only allows people a sense of mastery over technology, but it also provides direct benefits to business that digital machinist-driven automation simply cannot deliver.

COVID-19 and accelerated digitalisation efforts

COVID-19 has created an urgent need for organisations to accelerate their digitalisation efforts. The pandemic demonstrated the value of digital initiatives in e-commerce, deliveries, supply chain virtualisation, process automation, and other activities, especially where physical activities were no longer possible. The rapid responses to the pandemic made accelerating digital business critical for the survival of a company. Unfortunately, however, they paid little attention to health security standards despite enhanced time in digital working activities. The vast majority of companies were unable to cope with the crisis in this regard (Gabryelczyk, 2020).

Synthesis and conclusions

Beyond achieving final clarity and openness in the definition of health security, what concrete steps must be taken to implement the health security concept in the national interest, and how can we combine Smart Cities, blockchain, and health security within the Revolution 4.0?

The WHO has stated unequivocally that 'functioning health systems are the bedrock of health security', but it remains to be seen whether development partners, including donors in the so-called developed countries are prepared to make the technical and financial commitments for the development of health systems which are necessary to ensure that poor countries benefit from the timely and open sharing of information in accordance with the global health security concept. The cost of these commitments should not be underestimated; it is much more expensive to develop and maintain a national health system than it is to introduce national communicable disease surveillance and outbreak containment alone. However, failure to do this may result in a breakdown of health security for the rich and the poor alike.

Simply put, a blockchain is a digital record of financial transactions that allows users to securely and transparently store and transfer data. It is a decentralised network of computers that share data in a distributed, immutable, and secure way. Smart cities are cities that use technology to improve the quality of life for citizens by providing better services, improved infrastructure, and increased efficiency. Smart cities can therefore use blockchain to store and share data, allowing them to create systems that are secure, transparent, and efficient. BCT can be used to help improve urban infrastructure, public safety, energy efficiency, and access to services. For example, in the transport

[3] Digital humanism is the notion that people are the central focus in the manifestation of digital businesses and digital workplaces. Businesses who embrace digital humanism use technology to redefine the way people achieve their goals and enable people to achieve things not previously possible. Digital humanism stands in contrast to digital mechanism – a view that sees the minimisation of human involvement through automation as the central focus of technology.

sector, blockchain technology can be used to track the movement of vehicles and goods, help manage traffic congestion, and to provide secure payments for public transport.

In addition, blockchain technology can also be used to help manage public records, issue digital identities, store data securely, and facilitate the sharing of resources between public and private entities. Smart cities can also benefit from blockchain technology by using it to manage smart contracts and to ensure the secure transfer of data between citizens, businesses, and the government.

The Fourth Industrial Revolution is changing the way health is understood, transforming methods of treatment and diagnosis as well as the relationship between health professionals and patients while altering the management and organisation of health systems (Castroet al., 2020). The health sector is one of the sectors that is most exposed to technological evolution, so it is being impacted by digitisation, revolutionising the way healthcare is provided, from the actual interaction between patients and caregivers to governments and stakeholders (Schwab, 2017). Global health security is a global public good that is essential to the well-being of individuals, communities, and societies. The Industry 4.0, on the other hand, is the Fourth Industrial Revolution, which has transformed and revolutionised the use of technology in manufacturing and production.

While the global health security and the Industry 4.0 are very different in their nature, they have much in common. For example, both emphasise the importance of collaboration and data sharing in order to maximise efficiency and reach the desired outcomes. Furthermore, the Industry 4.0 technologies can be used to enhance global health security, such as through the use of artificial intelligence and machine learning to detect and respond to disease outbreaks faster. Additionally, new digital technologies can be used to monitor the compliance with global health regulations and to better coordinate global health initiatives. Finally, the Industry 4.0 can help to improve access to healthcare services, including telemedicine and remote monitoring technologies, which can be particularly beneficial in the so-called developing countries. Furthermore, AI can be used to track the spread of disease and identify potential outbreaks before they become pandemics. Robotics can be applied to assist with medical procedures and improve healthcare access in remote areas. Also, the Internet of Things can be employed to monitor the environment and detect potential threats to global health. By utilising the Industry 4.0 technologies, global health security can be improved, which will benefit everyone in the world.

Finally, the global health security can be thought of as a global public good, meaning that it benefits everyone in the world. The Industry 4.0, also known as the Fourth Industrial Revolution, is focused on creating digital solutions for businesses and governments to improve efficiency and productivity. This can be applied to global health security as well, as digital solutions can be used to help monitor, respond to, and prevent health risks on a global scale. Digital solutions can also be used to create secure systems for sharing health data, which can help ensure that health risks are addressed in a timely and effective manner. Additionally, the use of blockchain technology can be applied to create secure and transparent systems for managing health data, which can help facilitate better communication between countries and organisations regarding global health security.

By making these solutions accessible to everyone, we can help ensure that everyone is aware of the importance of global health security. To implement health security in the national interest, concrete steps must be taken to ensure that citizens have access to accurate and up-to-date information on health risks. Therefore, there is a strong need for a re-definition of global public health because of new challenges propelled by these new technologies. Furthermore, there is also a need to educate the public, policymakers, and providers about the impending transformation,

to modernise the existing governance systems and structures, and to develop a coordinated and collective framework[4].

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El Salvador's Adoption of Bitcoin from the Perspective of One Year: The Influence on the State Budget and a Comparison to Poland's Legislature

Abstract

Objectives: With each passing year, cryptocurrencies are becoming more popular and play an increasingly important role in economic trading. This growing importance is related not only to the increased interest in this subject, but also to the growing theoretical and practical problems. The author's goal is to portray circumstances and implications of the adoption of cryptocurrency by the Republic of El Salvador – which recently included bitcoin as part of the state budget – as well as discuss possibility of similar precedent in Poland.

Research Design & Methods: Cryptocurrencies are still a relatively new invention and, simultaneously, a complicated one. Therefore, reliable sources and references are still scarce, and those which exist are mostly in the Internet space. In the following article, I have used dogmatic-theoretical method of research in subsequent steps; I analyse proper subject literature, journalistic reports, as well as legal regulations.

Findings: El Salvador has become the first country in history that had decided to equate the status of a cryptocurrency with its native currency. Recently, it was also followed by the Central African Republic. However, the Republic of El Salvador takes a step forward and includes bitcoin as part of the state budget, thus binding the country's economic condition with the market pricing of cryptocurrency. A one-year's investment has, so far, gone negatively for the country, as Bitcoin price has declined sharply throughout the year. When comparing the situation of El Salvador to the Polish reality, it should be stated that cryptocurrencies may, in the current legal state, be part of the state budget. However, this applies only to single instances; therefore, such a negligible share can be omitted in further discussion. Certainly, adoption on El Salvador's scale is not currently possible. Apart from obvious risks, it would require a thorough reform of not only the legal system, but, above all, the economic mentality of the society.

Implications/Recommendations: Given the fact that Bitcoin is a cryptocurrency with neither issuer nor central authority, such step is to be considered a significant precedent in the history of world's economy and for cryptocurrencies themselves. Due to the well-known price volatility of the market, the adoption seems to be highly risky, but, if successful, it may bring measurable benefits to country's economy. However, the true question is – is it justified to base the state's budget, which is economic foundation of society, on cryptocurrencies? Almost a year after the adoption, bitcoin price is significantly lower and, consequently, El Salvador's loss is higher. Yet, bitcoin proved to recover many times – even after slumping over 90%. To conclude, it is advisable to observe El Salvador's economic situation in order to be able to more precisely define the impact of such a decision in the future, both on the country and on the cryptocurrency market itself.

Contribution/Value Added: The adoption of cryptocurrencies by El Salvador was broadly discussed not only in the cryptocurrency community, but also in the financial and economical ones. Journalists from around the world as well as international institutions such as the International Monetary Fund and the World Bank all became

Michał Wnęk – master degree in Law, Faculty of Law and Administration, Jagiellonian University – 1st place in contest organised by the *Przegląd Prawa Handlowego* monthly for the best thesis in the field of commercial law in 2021, with a thesis titled *Natura Prawna Kryptowaluty* [*The Nature of the Law of Cryptocurrency*], Chief Editor of *Bithub.pl*, e-mail: michal3wnek@gmail.com; ORCID: 0000-0002-0218-7679.

interested in the situation of El Salvador. In this article, I organise information, assessments, and opinions of the international community regarding the Salvadoran precedent. I also indicate whether and at what level cryptocurrencies can be part of the Polish budget under current legal regulations. The Salvadorian case, due to being a precedent, has already become a valuable lesson for the future legal proposals, research, and discussion. Yet, the development of such a situation may be surprising, which is why further observation is advisable.

Keywords: Bitcoin, cryptocurrency, El Salvador, state budget, Poland, Administrative Law

Article classification: theoretical (conceptual) article

JEL classification: K23, E58, F53

Introduction

On 7th September, 2021, El Salvador adopted Bitcoin as the country's other legal tender, alongside the dollar. From that point on, it has been possible to make payments using the cryptocurrency directly. This also applies to settlements with public institutions. The decision itself has left international public opinion stunned, yet the Salvadorian authorities went a step further. Indeed, Bitcoin has been incorporated into the state budget and is regularly acquired using public funds[1]. Bitcoin was also adopted as an additional legal tender by the Central African Republic (Zygiel, 2021)

The novelty of the topic, apart from it being a pioneering step, is about El Salvador causing a real debate on the possibility of accepting cryptocurrency as legal tender and even a national currency. This article, together with an entire series of other publications that have appeared primarily online, stands testament to the latter (Bitcoin.pl, 2021). This step, which not long ago seemed to belong in the realm of fantasy, is now discussed across various fields of social sciences (Alvarez et al., 2022). Economists and financiers have begun to closely follow the fate of El Salvador. This indirectly translates into more thorough analyses of the industry itself, leading to its development. Observing the Salvadorian case is important to hypothetical future adoptions in other states, as it will allow to correct possible mistakes.

How did a currency which has no issuer, and one that some – notably its fiercest critics – consider to be a financial pyramid, attain such a status? In this article, I provide an abridged history of cryptocurrencies and the circumstances in which El Salvador adopted cryptocurrency as legal tender. However, the main objective of this article is to analyse the influence that bitcoin adoption has exerted on El Salvador from the perspective of one year, as well as the possibility of the Republic of Poland following.

Material and methodology

I perform the analysis in a few subsequent steps, using dogmatic-theoretical method of research, combined with some minor calculations. First, I present the key terms referring to the article's subject alongside with a background of cryptocurrencies' historical development, which, in my opinion, is necessary to understand this novel topic. Secondly, I recall the key events portraying bitcoin adoption by El Salvador, combined with international overtones. Thirdly, I describe cryptocurrencies' legal background in Poland, highlighting key regulations.

I obtained data from various sources, depending on the subject of research. For the key terms, I used mostly scholars' literature which has increased vastly in recent years. Internet sources were inevitable to depict the adoption circumstances, alongside with institutional websites (for example the IMF site). Finally, when it comes to legal regulations in Poland, I based my findings on official legislative acts, followed by scholars commentaries, if available.

Combined with the time passed since the adoption, all this data allows me to address two main problems. First, what influence has El Salvador's decision exerted, not only on the country's

[1] When referring to the entire network, I use capitalised 'Bitcoin' and only in the singular, as in my opinion there is only one designation for the term 'Bitcoin', as is the case with the Internet network. When referring to the monetary units of the Bitcoin network, I use a lower case 'bitcoin', generally in the plural, as there are 21 million of the term. The technical details of the network will be discussed later in this paper.

state budget, but also on the international community? Second, is such a step possible in the Republic of Poland and could it be beneficial?

What is Bitcoin?

Bitcoin was launched on 3rd January, 2009, by the anonymous *Satoshi Nakamoto*[2]. It is a complete and organised software used as a payments system across the Internet. At first, it was known primarily within the IT community. It also attracted interest from liberal and even anarchist circles (Cohan, 2017). While the Creator's initial intention was to allow Internet users to make payments without the involvement of a trusted third party, it soon became apparent that the mechanism invented by *Nakamoto* had the potential for much more than just fast and secure online payments. In less than a decade, Bitcoin has gone from being a curiosity for geeks to being the focal point of interest for investors from around the world, funds, and state institutions (Duggan, 2022).

However, Bitcoin is not the only cryptocurrency that exists. In fact, there are thousands of them which aim to solve different problems and present various approaches[3]. The brightest example is Ethereum – the second cryptocurrency after Bitcoin. In contradiction to its predecessor, its main goal is to create a decentralised platform for developing applications, and not being a system of payments (Antonopoulos & Wood, 2019).

Cryptocurrencies began to emerge in large numbers in several past years and are increasingly seen as an alternative form of investment and a currency over which the state has no control. Spectacular price rallies and even more dramatic crashes have undoubtedly contributed to its rising popularity. The value of bitcoins has been known to increase by thousands of percent in a single year, only to fall by as much as 90 percent thereafter. Within a decade, the value of a bitcoin changed from a few cents to nearly 70,000 USD (Runkevicius, 2021). However, it was the technical aspects and potential deflationary features that attracted the original interest from those who saw the potential for the cryptocurrency's growth.

The term 'cryptocurrency' itself refers to a currency that is secured by cryptography and exists only in the virtual space (Kessler, 2022; Nakamoto, 2008). In fact, Bitcoin is simply a publicly accessible database (much like the Internet), although its main purpose it to serve as a system of payments, thus making it a widely accessible network inside the Internet. However, every participant of this network has equal privileges. In this system, there is no hierarchy as well as there are no administrators and no users. Anyone can contribute to sustaining the network (by multiplying and enhancing the database) and use it on equal terms. Just this brief description explains the interest from liberal circles, especially those with a socialist streak, alienated by the practices of state institutions (Iqbal et al., 2021)[4]. Since free and unlimited access to

[2] It is worth adding that the Creator remains anonymous to this day. We do not know who is hiding under the pseudonym Satoshi Nakamoto. Furthermore, there has been no communication with the Creator for nearly a decade. Effectively, this is tantamount to a definitive withdrawal from the project, which is now being developed by the community.

[3] The actual number of cryptocurrencies published on public websites varies depending on source, as it is sometimes difficult to consider particular project as a cryptocurrency or as still being used and developed. Based on *coingeko.com*, there are over 13,000 cryptocurrencies, whereas based on *coinmarketcap.com*, there are more than 20,000.

[4] One of the most known postulates of liberalism is '*laissez faire*', which refers to the lack of economic interventionism used by the state. Therefore, a currency without possibility of printing suits this saying perfectly.

the decentralised Bitcoin network, subject only to Internet access, is available to everyone, it began to develop into an alternative financial system (Livni & Lipton, 2021). There are even accounts on the Internet of people claiming to have completely stopped using cash, bank cards, or online transfers in favour of cryptocurrencies (Harrington, 2022). And that is not as ridiculous is it may sound. The number of entities – especially businesses offering goods and services – which accept bitcoins is increasing steadily (Ciesielski, 2021).

Twenty-one million is an important number when it comes to cryptocurrencies. This is the maximum number of bitcoins – the monetary units of the Bitcoin network, which, unfortunately, share common name, making it hard to differ between those terms[5]. Due to restrictions implemented in the source code, no more bitcoins can ever be created, and due to an automatic supply model, the last bitcoin is going to be created around year 2140 (Kim, 2019). The twenty-one million limit attracts supporters of a currency which is independent of government, as it not only lends a deflationary character to the project, but also makes printing additional bitcoins impossible. Therefore, similar hard-cap limits are introduced in alternative cryptocurrency projects[6].

This feature – alongside with the aforementioned decentralisation – is the main advantage of such currencies, according to adherents. The inability to print more money is one of the most important qualities of Bitcoin. However, its opponents counter that a certain amount of inflation is necessary – in line with the assumptions of some schools of economics (Skidelsky, 2011) – and, moreover, that control over money supply is required to handle various perturbations. And that is not possible with Bitcoin. At the same time, the lack of this control should be understood as the lack of discretionary influence over the functioning of the cryptocurrency, and not as chaos inherent in the functioning of the project. It is quite the opposite, i.e. everything is meticulously written down in the source code, therefore leaving little space for manipulation. A cryptocurrency has no issuer-guarantor, as it is with traditional currencies, where usually the state bank issues a country's currency, making it reliable based on its authority (Ofiarski, 2017). Instead, the issuer-guarantor's role – to a meagre extent – is essentially performed by computers. And it is these computers that implement the aforementioned network rules, as well as a number of other important features, and make sure that it constitutes a coherent whole (MonitorFX, 2022).

However, if there is no issuer-guarantor, and no entity is able to influence the currency, how can such a system be trustworthy? As I mentioned at the beginning, Bitcoin is actually a database that contains a range of information. This information is stored and processed according to the algorithms encoded by the Bitcoin's Creator in the IT source code. Computers, which perform a series of complex operations every second, make sure it is not possible to modify this code, or the information contained in the ledger (which could lead to Bitcoin's annihilation). On top of that, all the information in this ledger is public and publicly available, making it easier to identify any possible attempts to change it. The security of the entire network (database) improves as the number of computers 'defending' its integrity is on the increase. Modifying the information would – in theory – require computing power at least equal to that of the network itself. Considering that at the moment, the power of Bitcoin's network is greater than the world's 500 largest supercomputers combined, one would have to conclude that Bitcoin is the most secure database in existence (Santos, 2018); or at least in IT terms, as opponents continue to

[5] Cf. footnote 1.

[6] For example, Dash limit is 21 million coins, as it with Zcash. On the other hand, Ethereum does not have hard-cap limit, but its main function is not monetary, as was already mentioned.

make economic accusations against cryptocurrencies and also point out that there may be a yet unnoticed critical bug in the code (Meng, 2021). The technology for recording and storing data (known as blockchain) deserves a separate discussion in itself, as it is applicable to more than just a monetary system (Hassan et al., 2020).

Cryptocurrency, therefore, not only constitutes the first serious attempt to digitally represent value, but is also an attempt to eliminate the human factor from the currency operation process. This has only been made possible by the technological and scientific progress made in recent years. And it might take additional years or even decades to see whether these efforts were justified.

El Salvador's precedent

The following is a brief description of money without an issuer-guarantor, created by someone whose name and surname are unknown and secured by the computing power of machines. Money, which is impossible to print and, above all, whose price is incredibly volatile. Daily fluctuations of between ten and twenty percent and even more are no surprise to most market 'veterans'. At the same time, cryptocurrencies are often used in the process of committing various crimes, especially money laundering (Konieczny et al., 2018). This begs the obvious question of why a sovereign state, such as the Republic of El Salvador, decided to be the first in the world to recognise Bitcoin as legal tender and to base part of the state budget on bitcoin reserves. That decision may seem insane whilst being trivial and insignificant. This is primarily due to the rather limited significance of El Salvador on the international arena. However, this is a precedent that merely a few years ago seemed like the most exuberant fantasy of a cryptocurrency fanatic. The above becomes even more profound once the decision by the Central African Republic to integrate so staunchly with the cryptocurrency system is taken into account. While merely a few years ago such steps might have seemed like literary fiction, and even El Salvador itself might have been downplayed, today – in view of two separate states pursuing that path – this group is expected to expand in the near future.

However, there are two clearly separate issues here. First of all, in terms of cryptocurrency-friendly regulation, El Salvador is not a pioneer, and in most countries cryptocurrency trading is permitted and regulated to some extent; more on this below. What is a real precedent is the commitment of public funds to acquire bitcoins and to take active steps to encourage citizens to use the Bitcoin ecosystem. Since introducing the legal changes, El Salvador has been regularly acquiring further batches of the cryptocurrency. El Salvador's last bitcoin purchase was at the end of June and its total balance (as of November 2022) stands at almost than 2,400 BTC[7]. The country's President, Nayib Bukele, has very enthusiastically tweeted about subsequent bitcoin purchases[8]. And, incidentally, he was the main force behind the 'Bitcoin revolution' idea and was instrumental in convincing the parliament to pass the relevant laws. In adopting Bitcoin, Bukele sees an opportunity to attract foreign investors to the country and save on money transfer fees that poor people have to pay to intermediaries, as well as a chance for financial independence of the state and its citizens. Perhaps unsurprisingly, money transfers sent to families by Salvadoreans working abroad account for nearly a quarter of the country's GDP, so the potential savings could have a significant impact on the local economy (Kopańko, 2021). Furthermore, it should be noted that

[7] Data based on https://exchangerate.guru/btc/svc/9500/ (accessed: 12.02.2022)

[8] Cf. official twits on Twitter.com, https://twitter.com/nayibbukele/status/1542672286490271744

the vast majority of citizens have no realistic access to banking and, as such, financing through borrowing is not a viable option for them (*Investing.com*, 2021).

However, the new legal regulations coming into force have been met with considerable criticism from financial institutions as well as the indigenous population, where the President nevertheless enjoys considerable support (Jemioło, 2021). The World Bank has adamantly disassociated itself from El Salvador's actions and announced that it will not support the implementation of cryptocurrency payments (Campos, 2021). The Moody's credit rating agency has warned against the country's high risk of default, citing bitcoin investments among the reasons (Moodys, 2021). A communiqué from the International Monetary Fund states that 'The adoption of cryptocurrency as legal tender entails significant risks to financial and market integrity, financial stability and consumer protection' (IMF, 2022). At the same time, the IMF recommended to narrow the scope of the law on cryptocurrencies and increase supervision over the crypto-payment system. Indeed, as part of its cryptocurrency adoption programme, El Salvador has set up a special 150-billion-USD fund (Renteria, 2021). Businesses have been obliged to accept bitcoin payments and access has been provided for every citizen to the government's bitcoin wallet, where the equivalent of 30 USD will await each registered participant. These measures are aimed at encouraging the public to use this new legislative solution (Eyal, 2021). Despite international institutions issuing protests and recommendations, El Salvador's authorities remain adamant and refuse to comply with the IMF guidelines (IMF, 2022).

In spite of notable criticism, there were some who voiced their support for the path taken by El Salvador. Understandably, the cryptocurrency community itself was enthusiastic. Also, Ukraine began to consider taking similar steps (Parkin, 2021). Similar to Bukele, the incumbent President Volodymyr Zelenski is a well-known cryptocurrency fan. Preparatory steps for a wider adoption of cryptocurrencies were already taken in 2018, with 2023 as the target implementation year. Ukraine would become a dual-currency state, with the *hryvnia* and bitcoin in use alongside one another. Nevertheless, plans for such an integration are likely to be changed or at least delayed in the light of Russia's invasion. At the same time, Ukraine is not the only country seeking to replicate El Salvador's actions. Officials from Paraguay, Mexico, Brazil, and Argentina, to name but few, are also thinking along similar lines[9]. Such an approach by Latin American countries should not come as a surprise, as that is where actual cryptocurrency use has been on the rise for many years. In Venezuela, a government project for a centralised Petro 'cryptocurrency' was established as a solution to the country's continuing hyperinflation. However, the currency was criticised by a significant part of the community as well as Venezuelans (mainly due to centralisation), and, in retrospect, it can be said that the project was a failure (Adamiak, 2018).

Cryptocurrencies in Poland

Cryptocurrencies, and in particular Bitcoin, can be legally traded in the Republic of Poland. This conclusion is based not only on the lack of a provision prescribing a clear prohibition, but also on the letter of the Minister of Finance to the Speaker of the Sejm of 28 June, 2013, which stated that 'the operation and trading of virtual currencies in the Republic of Poland does not violate Polish or EU law'[10]. At the same time, the document states that Bitcoin does not meet the definition

[9] Cf. footnote 29.
[10] (BPS/043-30-1238/13), *Lex.pl*

of electronic currency in the light of the Act on Payment Services[11]. With the growing popularity of cryptocurrencies, trying to define Bitcoin in legal terms is the subject of an increasingly lively debate (Bala et al., 2016; Michna, 2018; Szewczyk, 2018; Zacharzewski, 2017; Behan, 2022). Without entering into a detailed discussion here, it should be noted that in the light of the current regulations, Bitcoin is not legal tender, as this is taken by, according to Article 32 of the Act on the National Bank of Poland, media of exchange issued by the National Bank of Poland. In fact, that institution has an exclusive monopoly in this sphere. Also, the definition of virtual currency, as it appeared in the Act on Counteracting Money Laundering and Terrorist Financing, states that a virtual currency is a digital representation of value which is not legal tender issued by the NBP or other central banks. *As per* the earlier discussion, when it comes to Bitcoin, it is difficult to talk of an issuer.

However, this is not the only component and, in fact, the definition itself is quite complicated, being a result of implementing EU law and the AML Directive[12]. The virtual currency is, therefore – from the positive side – a digital reproduction of value, which is convertible in economic transactions into legal means and accepted as a means of exchange, and can also be electronically stored or transferred, or may be the subject of electronic trade. On the other hand, from the negative side, the virtual currency will not be the above digital reproduction of value, as these belongs to: a) a legal payment means emitted by the NBP, foreign central banks, or other public administration bodies; b) an international settlement unit established by an international organisation and accepted by individual countries belonging to this organisation or cooperating with it; c) electronic money as understood by the Act of 19 August, 2011, on payment services; d) a financial as understood by the Act of 29 July, 2005, on trading in financial instruments; and e) a promissory note or check.

Such a multitude of requirements contained in the definition seems to darken the essence of cryptocurrency, and yet, taking into account the definition of virtual currency, one must also consider the equally extensive definitions of financial instruments or electronic money, to which the above definition referred to. Nevertheless, this is the legal framework. It should also be noted that the Polish law does not differentiate the legal situation of individual cryptocurrencies, which, if they meet the conditions of definition, will be considered a virtual currency. Some legislatures regulate this issue separately. In particular, it should be noted that El Salvador adopted Bitcoin only.

Cryptocurrencies have already been the subject of numerous rulings by common and administrative courts, as well as the Supreme Court[13] and the Supreme Administrative Court[14]. Unsurprisingly, the vast majority of cases were on tax law grounds. Finally, after numerous perturbations, aided by the position of the Court of Justice of the European Union, trading in cryptocurrencies becomes exempt from value added tax, similar to trading in traditional currencies[15]. Further, as a result of protests and administrative difficulties, cryptocurrencies have been exempted from tax on civil law transactions (Tabka, 2018),[16] while income from cryptocurrencies was classified similar to income on financial capital and taxed at a flat rate

[11] Journal of Laws 2011 No. 199 item 1175, as amended.

[12] Directive (EU) 2015/849 of the European Parliament and of the Council of 20 May 2015, Official Journal of the European Union L141/73.

[13] See, *inter alia*, Judgment of the Supreme Court of 3 June 2018; ref. no. II FSK 488/16; Judgment of the Supreme Court of 3 December 2009; ref. no. II CSK 550/09.

[14] Cf., *inter alia*, Judgment of the Supreme Administrative Court of 6 March 2018; ref. no. II FSK 488/16; Judgment of the Supreme Administrative Court of 19 August 2021 ref. no. I FSK 590/18.

[15] Judgment of the Court of Justice of the European Union of 22 October 2015; ref. C-264/14

[16] Article. 9 section 1a) of the Act on Tax on Civil Law Transactions (Journal of Laws of 2022, item 111, 655).

of 19% (compared to the previous rate of up to 32%)[17]. Finally, as of this year, exchanging or brokering in the exchange of cryptocurrencies is a regulated activity. This entails an entry in the register of providers of such activities and is subject to a number of requirements, including having no criminal record as well as relevant knowledge[18].

Following this brief discussion, one may conclude that the legal environment for cryptocurrencies has evolved positively. Not only have rules emerged creating a more secure footing for businesses and consumers, but also a certain body of case law has appeared in this area, providing a kind of behavioural guide for interested parties. Cryptocurrencies seem to have taken hold in both the economic and legal consciousness. Both the body of rulings and the literature on cryptocurrencies can be expected to grow for the simple reason that there is a clear trend towards increasing the use of cryptocurrency in business.

Looking at the general legal environment of cryptocurrencies in Poland in the backdrop of the situation in Latin America, one has to wonder whether Poland is ready for a similar step. The issue may be considered at two levels: legal and economic.

In legal terms, the permissibility of private trading in cryptocurrencies is not in doubt, although some public-law restrictions arise. The Treasury's general ability to acquire property, including stocks and shares, is assumed (Gniewek, 2017). Traditionally, a state's participation in economy is divided between two roles: the *dominium* sphere and the *imperium* sphere. The former one is plural and equal with other market participants, whereas the latter one is unequal and rather discretional. Since civil law transactions are permissible, the acquisition of virtual currencies by the State Treasury should also be considered permissible, at least within the *dominium* sphere, as a participant in economic trading on equal terms with other entities[19]. Limits in this respect are based on specific provisions, and there are no such specific provisions within the scope of cryptocurrencies at the moment. Article 9 of the Act on the Principles of Managing State Property, which prescribes the purpose for which the State Treasury may acquire shares, is an example of restrictions on the acquisition of shares[20].

The permissibility of acquiring cryptocurrencies is supported not only by the lack of restrictions, but also by their tax reclassification into the financial capital category. Stocks and shares are in the same category. Differentiating their status – in this respect – in view of such a notable legislative evolution and the creation of a relatively liberal trading environment would be inadvisable and without a convincing justification. It should also be mentioned that, since it would be possible to acquire shares in a company that actively invests in cryptocurrencies and is, therefore, strongly linked to their valuation, it would be reasonable to allow the acquisition of the cryptocurrency itself. Analogously, it should be considered that the same restrictions would apply to the acquisition of cryptocurrencies as for shares and stocks. Thus, the acquisition of a cryptocurrency should be considered primarily for the purpose of implementing a social or economic policy of the state. However, there is no denying that this objective is relatively broad with ample capacity for arguing a justification. Appropriate regulation in this area can be expected in the future, provided that

[17] Article 12 paragraph 12 item 11) and Article 1a of the Personal Income Tax Act (Journal of Laws of 2021, item 1128, as amended).

[18] Article 129 m et seq. of the Act on Counteracting Money Laundering and Terrorist Financing (Journal of Laws of 2018, item 723, as amended).

[19] *Ibidem.*

[20] Journal of Laws of 2016, item 1240, as amended.

cryptocurrencies continue to grow in popularity and importance across the business world. At present, the economic viability of such an acquisition is a separate issue.

The situation is somewhat more complicated for the *imperium* sphere, i.e. sovereign public-law relations, where other entities must obey the state[21]. Referring to the problem stated in the title, it should be pointed out that the budgetary procedure is a complex process that requires special care. The state budget is the economic foundation thereof, and no public body could function in the long term without financing. Therefore, including cryptocurrencies in the budget seems to be an overly risky exercise in terms of economics, considering their volatility and the lack of a guarantor. Nonetheless, it should be stated that to some small extent it is possible under the current state of the law and is mainly a consequence of the *dominium* sphere.

The primary legal act in this respect is the Public Finance Act of 27 August, 2009[22]. Pursuant to Article 3 thereof, public finance includes, *inter alia*, the collection of public revenues and incomes and the management of public funds. Further, Article 5 provides an extensive list of definitions explaining what public funds are. Pursuant to Article 5 paragraph 1 item 4b, these are, *inter alia*, state budget revenues from the privatisation of State Treasury assets. Article 5 paragraph 1 item 8) which, in case of doubt, will also apply here, is somewhat complementary to this provision. Accepting the permissibility of the Treasury acquiring virtual currencies may lead to a situation where the assets that they were part of are going to be privatised. A similar conclusion follows from Article 5 paragraph 2 item 1), which lists certain public revenues. Among these is a profit contribution by national companies and State Treasury-owned companies. One also has to mention the institution of forfeiture, which can be applied to cryptocurrencies struggling with a 'criminal label'. While it may be debatable whether Article 44 or 45 of the Criminal Code[23] will apply due to dematerialisation, the admissibility of the institution itself should not be in doubt. Funds from forfeiture are taken over by the State Treasury; it is worth emphasising that cases of cryptocurrencies being confiscated are not literary fiction, as they have happened in the past (Hern, 2020; Business Insider Polska, 2017)[24]. Finally, the possibility of donating, bequeathing, or bequesting to units in the public finance sector, which by virtue of Article 5 paragraph 2 item 5) are public revenues, should also be mentioned. The same will apply to statutory succession in the absence of a will and statutory heirs (Article 935 of the Civil Code).

Results

The study of the Salvadorian case shows that the very first problem that a particular country needs to address is international criticism, especially from important financial institutions such as the International Monetary Fund or rating agencies, which can further lead to economic isolation. Although this issue would probably become less vital in the future if more countries were to follow suit, the criticism has put El Salvador in a difficult situation. As the country's economy has been recently worsening, it seeks help, and the World Bank refuses[25]. In order to grant development aid, the IMF requires conducting certain reforms, one of which is reversing Bitcoin adoption – a step which President Bukele persistently rejects (Reuters, 2022). Lowering the country's rating

[21] Cf. footnote 49.
[22] Journal of Laws 2009 No. 157 item 1240, as amended.
[23] Journal of Laws 2022, item 1138, 1726, 1855.
[24] Among the most famous was the American FBI confiscating more than 170,000 bitcoins from Silk.
[25] Cf. footnote 31.

makes the situation even worse, causing borrowing money to be more expensive, as worse rating involves higher risk for lender, thus generating the need to compensate it with a higher interest rate.

Once a particular country manages to deal with criticism (or perhaps its economic situation is better), another threat is risk involved with cryptocurrency market pricing. A one-year's perspective clearly shows its significance. As I highlighted in the beginning of the article, cryptocurrencies are well-known for being volatile and the current year, alongside with the previous one, confirms it neatly. After reaching a price of nearly 70,000 USD per bitcoin in early November 2021, it then dropped to below 20,000 USD in the middle of June 2022. The price of bitcoin fell by more than 80% in just seven months, making El Salvador's loss significant. In fact, dollar cost average price for El Salvador is 45,000 USD, with bitcoin price itself being 20,000 USD, contributing to a nearly-60% loss since the beginning of the adoption. Taking into account these circumstances, the fact that El Salvador's case is held to be inspirational through some countries is only a small consolation for the Pioneer itself – at least until more followers are to be found.

From another perspective, one may claim that had El Salvador bought bitcoins earlier, it would have still had a decent profit. The same conclusion could be proposed if bitcoin was to gain in price again in the future, which is possible considering, once again, strong volatility and historical price action. Conceding this statement to be truthful (e.g., bitcoin price in October 2021 was 10,000 USD), it is at least questionable whether a country's economic condition should be based on not only one of the most risky assets in the world, but also a very young one and, thus, highly unpredictable.

Despite the fact that El Salvador's unrealised loss is nearly 60% of the investment, President Bukele remains unshaken (Sigalos & Kharpal, 2022). He continues to systematically acquire further batches, leading to the price averaging out (Bellusci, 2022). Thus, any subsequent price increases would mean a sizeable profit for the Republic of El Salvador, in practice impossible to generate on any other market in such a short term. However, this is only an assumption, as future prices cannot be predicted with any certainty, and such a gamble with public funds seems extremely risky and could end tragically for the general public. The relatively significant dissatisfaction of the local population – particularly business-owners, who have been forced to revolutionise the way they do business in a fairly short space of time – is also noteworthy. Public protests continue to take place, so it seems that another several months are necessary to have a fuller picture of the situation (Renteria, 2021).

When it comes to an analysis of the Polish case, cryptocurrencies have been granted a firm position in recent years. Not only were they legally defined, but also first regulations on running cryptocurrency business started to appear, alongside with some tax concessions. It seems that the participation of cryptocurrencies in the state budget is possible, although it is somewhat forced, passive, and incidental. In fact, those cases are so exceptional that they seem to be negligible. While the phrase 'management of public funds' in Article 3 item 5) of the Public Finance Act of 27 August, 2009[26], is quite broad, it does not seem to include the possibility of converting some public funds into cryptocurrencies, thus making it impossible to obtain any considerable amounts under state's *imperium* sphere. In contradiction, it seems to be much easier for The State to obtain cryptocurrencies in the *dominium* sphere, where regulations are not as strict. Yet, this seems to be justified, as this part of state participates in the economy on the equal, free-market rules, as other participants do. Still, there is no evidence for acquiring any significant cryptocurrency, even in this sphere, which, in my opinion, indicates reasonable governing.

[26] Journal of Laws 2009 No. 157 item 1240, as amended.

Concluding Remarks

If Bitcoin or other cryptocurrencies were recognised as legal tender in Poland, a certain proportion of public revenue and income would necessarily be collected in the form of cryptocurrencies. The introduction of such a possibility into the legal system would, in practice, require an actual investment of public funds in cryptocurrencies. Otherwise, it would be irrational to allow such an option and immediately re-exchange crypto-income as soon as it flows into the Treasury. Storing some part of public funds in crypto-assets would, in turn, probably raise discussion on whether to increase that share or not. From this point it takes just one step to allow the Salvadorian option, although a thorough reform of many domestic law branches would be required. One may, therefore, assume that such a regulation will not appear any time soon, if it is at all possible in the legal and economic culture of Europe.

When addressing this issue at an economic level, it is necessary to answer the question of whether the share of cryptocurrencies in a state budget is beneficial and, thus, whether it would make sense to conduct relevant legislative changes. Studies on bitcoin price action and Salvadorian case show that it may be beneficial, but the reality has verified the – perhaps too optimistic – predictions, leaving El Salvador with a considerable loss. All sorts of risks associated with such a novel construct as cryptocurrencies are surfacing. Firstly, the lack of an issuer-guarantor means that the entire risk of an undertaking is borne by the investor. Secondly, very significant price fluctuations are a factor that amplifies risk and uncertainty. However, it should be noted at this point that, despite spectacular crashes, the price of bitcoin has been rising steadily in a wider time frame, though it may not always be the case. Thirdly, one has to bear in mind the ever-present possibility of project failure caused either by a critical error in the code or by a final economic unsuitability that may not manifest itself until some time later.

Compared to gold, which has been the basis of national reserves for millennia, the age of cryptocurrencies, counted in a dozen years, speaks for itself. The risk is, therefore, considerable and, as such, any possible economic commitment should be proportional to it. State institutions engaging in such operations would be bordering on gambling. However, one can already find international funds that cautiously include cryptocurrencies in their investment portfolio, but they do so for a very negligible percentage of money (Semenova, 2021). This seems like a reasonable strategy, one that minimises losses while, in the event of success, leading to a sizeable profit to compensate the efforts.

Finally, it has to be said that, while a passive observation of the actions taken by other countries rules out the possibility of a pioneering cryptocurrency adoption, it also avoids any possible perturbations associated with the new situation, and as such seems most appropriate. The fact that countries in a fairly poor economic situation are deciding or considering such a step in the first place also seems quite critical. When it comes to El Salvador, the CAR or Venezuela, such an 'experiment' is perhaps a last-ditch attempt before bankruptcy. Regardless of the position taken on this matter, it has to be said that Poland is not a country that would require such drastic measures, even though its debt is approaching a critical level[27]. In my opinion, for the time being, the best strategy is to observe the situation. Any possible pro-cryptocurrency actions should be taken

[27] Based on Eurostat data, Poland's public debt constituted 56.6% of its GDP in the third quarter of 2021. Meanwhile, pursuant to Article 86 of the Public Finance Act (Journal of Laws of 2019, item 869, as amended), the Council of Ministers is obliged to take remedial measures once the debt exceeds 55% of the country's GDP, with 60% of GDP being taken as a critical point.

once harmonisation at the European level becomes possible. Public funds, which by definition are 'public', are too valuable an asset to take such a huge risk alone.

The study of the Salvadorian case leads me to a conclusion that making cryptocurrencies a part of the state budget is inappropriate and even irresponsible, as public funds are the society's economic foundation. It is also not recommended to make Bitcoin or other cryptocurrencies legal tender too soon. Despite the fact that it may be beneficial to allow wider payment liberty for citizens and enterprises, such a step requires multilevel changes in the structure of law system and, therefore, should be proceeded with great caution. As for now, it seems that the best option, one which balances risks and opportunities, is to make regulations encouraging the private sector to develop this industry. Once it grows enough and becomes more stable, re-discussion is advisable. Also, further observation of El Salvador's path is strongly recommended, especially its return on investment, since this country seems to be far from reversing its course.

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How to Reduce Low-Stack Emissions? An Assessment of the Willingness of Residents of Single-Family Houses to Replace Fossil Fuel Heating Systems

Abstract

Objective: The objective of this study is to determine whether occupants of single-family houses in Poland, where low-stack emissions have a particularly negative impact on air quality, are willing to replace their current fossil fuel heating systems. To that end, four research hypotheses were formulated: 1. The majority of households using solid fuel boilers are considering switching to another heat source; 2. Their willingness to replace solid fuel boilers is affected by several statistically significant factors; 3. The main impediment to replacing the heat source is its cost; and 4. The anticipated amount of subsidy is critical in deciding whether or not to purchase a new heat source.

Research Design & Methods: This research was considered in the context of data from a CATI survey conducted in July and August 2021 among a representative sample of occupants of single-family houses in Poland. A total of 1007 responses were collected, of which 432 were considered in the subsequent analysis. A literature review, questionnaire results analysis, and a logit regression model were used to verify the hypotheses.

Findings: 1. Nearly 80% of the respondents would like to replace their heat source, but only 20% are considering ecological heat pumps; 2. People with more knowledge about renewable sources, who are more concerned about the environment and live in older houses, are more likely to replace their heat sources; 3. The high cost of purchasing a new appliance, low subsidies or lack thereof, and the fear of rising bills are the main factors slowing the transition; 4. Higher subsidies increase the number of people willing to replace their heat sources, with the median expecting at least a 50% replacement subsidy regardless of the price of the appliance.

Implications/Recommendations: The results of the study can be used by decision-makers when formulating and adapting support programmes for people replacing old and inefficient solid fuel boilers.

Contribution/ Value Added: The research results indicate the issues that have not been formulated in the literature so far, regarding the factors determining the willingness to replace old fossil fuel boilers. The added value of this article is the indication of statistically-significant variables such as the age of the house, knowledge about renewable energy, and attitude to the environment, which affect the willingness to replace.

Article classification: research article

Keywords: heating transformation, low-stack emissions, single-family houses, preference analysis

JEL classification: Q42, Q56, R11

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Introduction

The importance of phasing out coal-fired heating systems is underscored by the fact that Poland's air quality is generally poor, as noted, among others, by the European city air quality viewer (EEA 2021), which identifies a number of Polish cities where the levels of PM2.5 exceed WHO standards. According to current guidelines, the maximum average annual PM2.5 concentration should not exceed 5 $\mu g/m^3$ (WHO, 2022b). In 2017, the figure for Poland was 23 $\mu g/m^3$; Poland thus ranked fourth among the European Union countries with the worst air quality (Adamkiewicz & Matyasik, 2019). In 2021, the average PM2.5 concentration in Poland exceeded the annual WHO guideline 3.8 times (IQAir, 2022).

A major contributor to air pollution is low stack emissions caused by the combustion of solid fuels (mostly coal and wood) by households and small manufacturing facilities (Adamkiewicz et al., 2021). Households that use fossil fuels for heating purposes are largely responsible for these emissions, which are particularly evident during the heating season (Frankowski & Herrero, 2021). According to recent data, 55% of households still use solid fuel boilers, more than half of which are old, low-grade, and predominantly coal-fired appliances (GUNB, 2022). In Poland, air pollution has a number of negative consequences, including lower health quality and a nearly three-year reduction in life expectancy (EEA, 2019). Moreover, studies show that it costs the domestic economy between 40 and 120 billion PLN annually (Adamczyk et al., 2017).

The literature lacks research explicitly devoted to the factors that account for the limited interest in switching from solid fuel heat sources to more environmentally-friendly ones. In Poland, most studies similar to those conducted by the authors of this paper have been produced by the Polish Smog Alert (Adamkiewicz et al., 2021; Pytliński, 2016; Pytliński et al., 2021; Wietrzny & Dworakowska, 2019). Dąbrowski (2022) demonstrates how coal consumption policies affect PM2.5 emissions, whereas other studies focus on the impact of anti-smog resolutions on coal consumption (Stala-Szlugaj, 2018) and low stack emissions (Flaga-Maryańczyk & Baran-Gurgul, 2022). An examination of reasons for replacing solid fuel boilers, including those cited by the beneficiaries of programmes promoting the transition to clean heat sources, revealed that households were hesitant to abandon solid fuel heating mostly due to the perceived uncertainty about future energy prices and supply availability (Frankowski & Herrero, 2021). The vast majority of studies address the impact of low stack emissions on the health of residents (e.g. Kowalska, 2020; Traczyk & Gruszecka-Kosowska, 2020; Zieliński et al., 2018).

Although the research reported in this paper clarifies and expands on certain topics previously covered in the literature, its findings are extremely relevant given the current energy crisis enhanced by the conflict in Ukraine. Identifying the disincentives to energy transition, as well as the current scale of the problem, may thus prove to be of interest to policymakers.

The aim of this article is to investigate the factors that affect the use of coal by single-family house occupants in Poland. Four research questions were proposed to this end:

1. What percentage of households that use solid fuel boilers do not intend to replace their heat sources?
2. What factors affect people's willingness to replace their heat sources?
3. What factors are the most likely to prevent people from replacing their heat sources?
4. What subsidy levels would effectively induce people to replace their solid fuel boilers?

Questions (1) and (4) will be addressed using the existing research (Pytliński, 2016; Pytliński et al., 2021; Zaborowski & Walczak, 2018), whereas answers to (2) and (3) are intended to

complement the existing state of knowledge. In this way, we set out to show not only how many people are willing to replace their heating systems but also what factors affect their attitudes. To that end, we shall review the selected literature and data from our CATI survey of 1007 households, 432 of which stated that they heated their homes with a solid fuel boiler. This paper is structured as follows: (1) Introduction; (2) Literature review on research into the use of coal boilers and low stack emissions; (3) Description of the research methods; (4) Presentation of the survey results and statistical analysis, and discussion with particular focus on measures that should be taken to reduce low stack emissions; (5) Conclusions.

Literature review

In Poland, more than 10 million tonnes of coal are burned each year by households – mainly by a large proportion of the 5.5 million existing single-family houses (Łukaszczyk, 2018). A number of studies in the literature address the relationship between the use of solid fuels and local air quality (Mamica, 2022; Wierzbińska & Adamus, 2020).

The replacement of a large number of solid fuel boilers before to the 2017–2018 heating season resulted in improved air quality in Kraków, with a marked decrease in the average PM10 and PM2.5 levels (Rataj & Holewa-Rataj, 2020). It is worth noting that clean air is one of the three main goals of the Energy Policy of Poland until 2040 strategy, which also include a fair transition policy and a zero-carbon energy system. The primary goal of the strategy is to transform the heating sector (district and individual heating systems), electrify transportation, promote zero-emission and passive housing. The strategy identifies a number of actions that, if implemented, should eventually solve Poland's air pollution problem. The following objectives are set forth in the strategy: increasing the number of efficient district heating systems; investment in heat pumps and electric heating; a shift away from household coal combustion (by 2030 in cities, by 2040 in rural areas); improving the energy efficiency of buildings and moving towards zero-emission transportation by 2030 in cities with populations of more than 100,000 (Ministry of Climate and Environment, 2021).

In order to reduce low stack emissions, it is critical to stop using solid fuels to heat buildings. Heat pumps appear to be a viable option in this regard. A recent study found that switching to a heat pump (or gas heating) without considering thermal retrofit reduces the amount of particulate matter and benzo(a)pyrene emissions produced by households by nearly 100%. Another method of lowering stack emissions is to improve thermal insulation, which can reduce emissions by 65% per dwelling while also significantly lowering seasonal heating expenses. It should be taken into account that the replacement of coal boilers, and thermo-modernisation also leads to a reduction in CO_2 emissions (Mamica, 2022).

Low stack emissions are the most significant contributor to smog (Kazmierska-Patrzyczna, 2022). In 2018, the Clean Air Programme was launched with the primary goal of supporting the replacement of 3 million off-grade boilers and performing thermal upgrades. The programme has a budget of €22.4 billion and its targets should be achieved within ten years (Blazy et al. 2021). Subsidies, however, are only one tool for addressing the issue. Adoption of anti-smog resolutions or laws, such as prohibiting the use of low-efficiency solid fuel boilers in a specific area, is another. In early 2017, the Małopolska region passed the first anti-smog resolution, which outlined the requirements for household solid fuel boilers and placed restrictions on the type of fuel that could be used (Polish Smog Alert, 2022). In 2019, a total ban on solid fuels for heating was

enacted by Kraków, and by January 2021, 14 out of Poland's 16 provinces had introduced similar anti-smog measures (Polish Smog Alert, 2022).

Despite these measures, one of the factors impeding the transition to low-carbon sources was the lack of reliable information on the types of heating systems actually used by households (Pietras-Szewczyk, 2021). Until recently, it had primarily been based on various types of estimates, including those by Pytliński (2016), Pytliński et al. (2021), Zaborowski and Walczak (2018). Since 1 June, 2021, however, all property owners and managers in Poland have been required to report the heat sources they own and use to the Central Emission Register of Buildings (CEEB). As of 24 November, 2022, 33% of the 9 million CEEB entries comprised solid fuel boilers with manual or automatic feeders, 6% coal boilers, 5% solid fuel masonry heaters/stoves, and 11% fireplaces, freestanding iron stoves, and solid fuel air heaters. A quick calculation reveals that approximately 55% of the surveyed households still use solid fuel (coal being by far the predominant one). Furthermore, more than half of the solid fuel boilers (51.4%) are rated as low-grade or off-grade (i.e. below class 3; cf. GUNB 2022). The types of heating fuels included in the CEEB demonstrate unequivocally that more needs to be done to address the issue at hand. Several studies show that individuals' quality of life is severely impacted by poor air quality (Kowalska, 2020; Traczyk & Gruszecka-Kosowska, 2020; Zieliński et al., 2018).

Table 1. Cities in Poland with annual mean PM2.5 emissions above 20 μg/m^3 in 2021

City	EEA Ranking (total 344)	Mean annual concentration of PM2.5 (μg/m^3)
Nowy Sącz	344	26.8
Zgierz	337	22.5
Łomża	336	22.4
Gliwice	335	22.1
Żory	334	22.1
Katowice	329	21.4
Piotrków Trybunalski	328	21.3
Kalisz	325	20.8
Kraków	324	20.8
Kielce	323	20.7
Bielsko-Biała	322	20.7
Lublin	321	20.4

Source: own study based on EEA (2021).

Numerous studies have demonstrated that particulate matter (PMx) has an extremely negative impact on human health (Adamkiewicz et al., 2021). Ambient air pollution has been identified as a significant environmental health risk factor, contributing to the premature death of approximately 4.2 million people each year (WHO, 2022a). It reduces life expectancy by 2.8 years in Poland, and by 2.2 years in Europe (EEA, 2019). According to studies, Poland may be losing up to 120 billion PLN per year as a result of hospital admissions and missed workdays by people whose health has been adversely affected by exposure to particulate matter and benzo(a)pyrene (Adamczyk et al., 2017). Table 1 shows the most polluted cities in Poland by PM2.5. In as many as 12 of them, air pollution exceeds 20 μg/m^3 (by comparison, the current WHO standard is 5 μg/m^3; cf. WHO

2022b). The table clearly shows that the problem with PM2.5 air pollution mainly affects Poland and Italy, as well as a handful of cities in Croatia, Bulgaria, and the Czech Republic (EEA, 2021).

It should be emphasised, nevertheless, that low stack emissions can vary in nature and are affected by a variety of factors depending on the locality. PM2.5 is merely one of several dangerous substances that contribute to smog. Others include nitrogen oxides, PM10, and PAHs (polycyclic aromatic hydrocarbons), which are primarily the side effects of road transportation (Adamkiewicz & Matyasik, 2019).

Research methodology

The analysis relies on data from a CATI survey conducted in July and August 2021 among a random sample of individuals who own or live in single-family homes in Poland. Since approximately half of the country's population lives in single-family houses and more than half still use solid fuel boilers, the selection of this group appears justified; additionally, respondents came from all over the country, hence the survey can be considered representative. The questions (yes/no, single-choice, multiple-choice, and open-ended) addressed various aspects of energy transition, such as self-assessment of the respondents' knowledge, attitudes, behaviours, and plans to implement energy-saving measures. A total of 1007 responses were collected, of which 432 homeowners were selected who marked one of the following as their main heat source: 1. solid fuel boiler (coal, wood or biomass) with a manual feeder; 2. solid fuel boiler (coal, wood or biomass) with an automatic feeder; 3. solid fuel masonry heater/tiled stove (coal, wood or biomass); 4. coal-fired stove/boiler. The list of heat sources was taken from the form that residents were obliged to complete for the CEEB. For the purpose of this study, 12 survey questions were used.

The study aimed to determine whether people who use solid fuel boilers are open to switching to another heat source as well as what factors affect their willingness to do so. To this end, the following research hypotheses were formulated, which correspond to the research questions mentioned above:

H1: The vast majority of households using solid fuel boilers are considering switching to another heat source,

H2: Their willingness to replace solid fuel boilers is affected by several statistically-significant factors,

H3: The main impediment to replacing the heat source is its cost,

H4: The anticipated amount of subsidy is critical in deciding whether or not to purchase a new heat source.

In order to test these hypotheses, descriptive statistics were analysed for both the respondents and the buildings in which they live. A logit regression model was also used in the study. In the final stage of our investigation, we looked at the most effective level of subsidy for replacing the heat source.

Results and Discussion

Table 2 shows the survey participants' demographics, including gender, age, education, and labour market status, as well as the period of time in which their house was completed. The survey participants were also asked about their self-assessed level of environmental awareness and familiarity with renewable energy sources, since these two factors were considered likely

Table 2. Descriptive statistics of the studied population, including awareness of environmental issues and familiarity with RES

Feature	Specification	N	Percentage
Gender	Male	168	38.89
	Female	264	61.11
Age bracket	Below 25	55	12.73
	25–34	139	32.18
	35–44	103	23.84
	45–54	75	17.36
	55–64	155	35.88
	65 or more	20	4.63
Education	primary	7	1.62
	lower secondary	6	1.39
	basic vocational	55	12.73
	secondary	189	43.75
	Higher	175	40.51
Labour market status	private sector employee	190	43.98
	public sector employee	81	18.75
	self-employed	30	6.94
	farmer	14	3.24
	student	29	6.71
	pensioner	41	9.49
	unemployed and others	47	10.88
House completed (in)	before the 1980s	133	30.79
	the 1980s	67	15.51
	the 1990s	81	18.75
	2000–2010	80	18.52
	2010–2020	62	14.35
	after 2020	9	2.08
Awareness of environmental issues	very high	196	45.37
	high	147	34.03
	average	75	17.36
	small	8	1.85
	very small	6	1.39
Familiarity with RES	very high	72	16.67
	high	155	35.88
	average	171	39.58
	small	30	6.94
	very small	4	0.93

Source: own study based on CATI results.

to affect their willingness to switch to more ecological heat sources. For this reason, they were included in analysis.

Most survey participants were female (61.11%). The 55–64 age bracket was the most numerous (35.88%), followed by those aged 25–34 (32.18%). More than 40% of survey participants worked in the private sector, with public sector employees coming in second. Over 80% of the respondents had a university degree or completed secondary education. About 3% had primary or lower secondary education. The largest group in the survey was made up of people living in houses built in the 1990s, and between 2000 and 2010, respectively (both over 18%). The smallest group lives in houses built after 2020 (2.08%). More than three-quarters of those surveyed said they cared or cared a lot about the environment with only 4% reporting little or no awareness of environmental matters. The largest group (39.58%) considered their familiarity with renewable energy sources as average, whereas 35.88% claimed to have extensive knowledge of RES.

Willingness to replace solid fuel boilers

When asked whether they would be prepared to switch from their current heat source to another, the respondents were also requested to indicate what kind of appliance they would like to replace it with (cf. Figure 1). Seventy-seven per cent of the respondents were open to this possibility, but 18% declared their intention to purchase a biomass boiler (i.e. one that uses wood pellets as fuel). Switching from, for instance, a low-grade coal boiler to a modern biomass-fired one was viewed as a positive development, since our study focused on generally conceived readiness to replace. However, even though pellets can be seen as an improvement on coal, they only reduce rather than resolve the issue of pollution. The same can be said for gas, which is currently regarded as a transitory energy source. The latter option was chosen by 22% of the respondents, a further 20% opted for heat pumps, widely regarded as the most promising and environmentally-friendly solution, while 9% contemplated switching to electric heating.

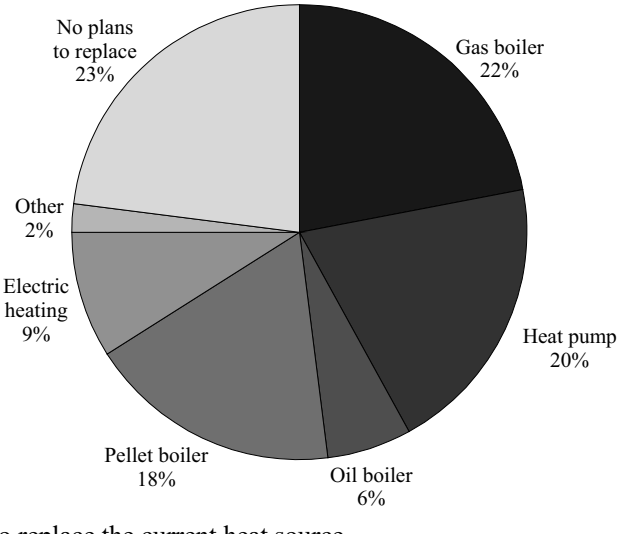

Figure 1. Willingness to replace the current heat source

Source: own study based on CATI results.

As a result, despite their willingness to replace their heat source, only about 30% of the survey respondents are thinking about switching to a zero-emission fuel, with the remainder viewing it as a more temporary solution. However, it should be noted that converting to gas, for example, would significantly alleviate the problem of low stack emissions in Polish cities, and as such is regarded as desirable from the perspective adopted in this paper.

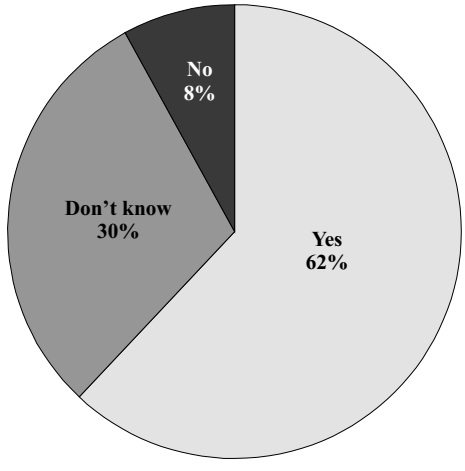

Figure 2. Willingness to switch to an environmentally-friendly heat source under duress

Source: own study based on CATI results.

Further, the respondents were asked whether they would install a heat pump or a solar panel-assisted heat pump if they were forced to abandon their current solid-fuel heating system. As many as 62% said they would replace it, 30% said they did not know, whereas only 8% responded in the negative.

Factors that affect the willingness to replace solid fuel boilers

In the next stage of the analysis conducted in this study, a logit regression model was developed (logit regression allows the prediction of a future outcome based on a set of predictor variables).

In our study, the regression is given by the formula:

$$Y_i = \beta_0 + \mathrm{Sex}_i + Age_i + Education_i + Job + Houseage_i + Environmentalawareness_i + \\ + FamiliaritywithRES_i + \varepsilon_i \quad (1)$$

The willingness to replace coal heating with an alternative energy source was the dependent variable (with 1 denoting the willingness, whereas 0 unwillingness to replace). Explanatory variables included the time period in which the house was built; gender and age of house occupants; their education, occupational status, environmental awareness, and familiarity with renewable energy sources. The amount of subsidy had no effect on the decision to replace, as confirmed by the Wald test (Bursac et al., 2008). Our analysis thus focused on the factors shown in Table 2.

The estimated logit regression model is correct. The model itself is statistically-significant, which was attested by the likelihood ratio chi square statistical test, with 37.60 for 7 degrees

of freedom (information criterion AIC 551). To check how the model fit the data, we calculated the pseudo R (McFadden), which was 0.062, whereas the Cox and Snell pseudo R was 0.12. These low values may indicate a poor data–model fit, which may be due to the relatively small number of observations (Greene, 2003). However, the Brier score, which measures the accuracy of probabilistic predictions, was 0.21. Such a low score confirms that the predictive value of the model is good (Brier, 1950). Taking into account the three different measures of estimation, we can consider our model to be correct.

Table 3. Logit regression model for 7 studied variables

	Variable	Estimate	Std Error	z value	Pr(>|z|)	Odd Ratio
β_0	Intercept	–2.263	0.847	–2.672	0.008	0.104
β_1	Gender	–0.058	0.221	–0.260	0.795	0.944
β_2	Age	–0.085	0.084	–1.011	0.312	0.919
β_3	House age	–0.172	0.072	2.390	0.017	1.188
β_4	Education	–0.223	0.295	–0.757	0.449	0.800
β_5	Ecological awareness	0.468	0.126	3.706	0.000	1.597
β_6	Job	0.039	0.218	0.177	0.860	1.040
β_7	Familiarity with RES	0.286	0.130	2.188	0.029	1.331

Source: own study based on CATI results.

Accordingly, the statistically-significant variables that affect the decision to replace the heat source are: 1. the age of the house; 2. the occupants' environmental awareness; and 3. the occupants' familiarity with renewable energy sources. Because the *p* is greater than 0.05, the remaining variables, such as the respondents' gender and age, occupation, or education, are not statistically-significant. As a result, these factors have no bearing on the decision to replace the heat source in this survey. The crucial factors in order of significance were environmental awareness, familiarity with renewable energy sources, and the age of the house. The greater the age of the house, environmental awareness, and familiarity with RES, the greater the willingness to replace the heat source.

Disincentives to replace solid fuel boilers

Next, we attempted to estimate which factors have the greatest negative impact on people's readiness to switch to a different heat source. For this purpose, we selected 10 factors that, in our opinion, were most likely to affect energy transition in Poland. These factors are shown in Figure 3 along with the percentage of people who feel that a particular one has a negative impact on their decision to replace their solid fuel boiler.

High costs of purchasing a new appliance (69.4%); little or no subsidy (66.8%); concern about higher bills (56.5%); lack of knowledge of full purchase and running costs (54.4%); complicated installation process (53%); complicated subsidy application procedure (45.1%) were mentioned as disincentives to replace the heat sources. The least popular responses were: negative feedback from others and the belief that replacing the heat source has no effect on air quality. Thus, more than 60% of people recognise that the type of heating they use affects air quality, and more than 60% are unconcerned about negative feedback from others, which is a positive trend.

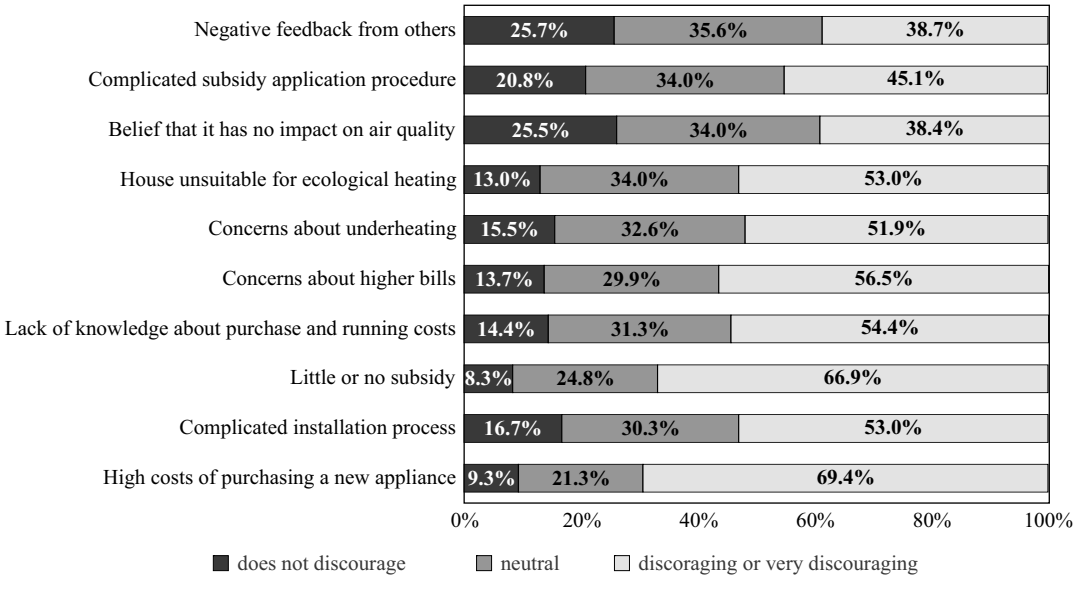

Figure 3. Disincentives to replace the current heat source

Source: own study based on CATI results.

It should be noted that replacing a heat source is very expensive; in fact, three of the most significant disincentives are financial in nature.

Expected subsidy levels

The final section of the survey focused on hypothetical subsidy levels expected to induce single-family households to replace their solid fuel boilers. To that end, two questions were asked about the anticipated subsidy levels for appliances worth 20,000 PLN and 40,000 PLN, respectively, which reflect the various purchase and installation costs. Figures 4 and 5 show the final results.

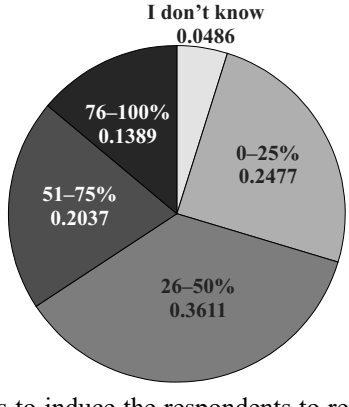

Figure 4. Expected subsidy levels to induce the respondents to replace their heat source if the total replacement cost was 20,000 PLN

Source: own study based on CATI results.

Almost a quarter of those surveyed would like to receive a replacement subsidy of up to 5,000 PLN with the optimal amount around 26–50% of the total replacement cost. Interestingly, 27% of the respondents put the optimal subsidy at 50% of the total cost. Only 13.89% expected a subsidy greater than 15,000 PLN, with 8% expecting the subsidy to cover all the expenses incurred. Almost 5% of the respondents were unable to specify the preferred amount. It should be noted that if the hypothetical subsidy did not exceed 25%, only one-quarter of the survey participants would be interested; however, if it was increased to 50%, the interest rose by 36%. By comparison, a 75% subsidy translated into an additional 20% increase. Finally, if the subsidy covered all the costs, a further 14% of the respondents would consider replacing their heat source.

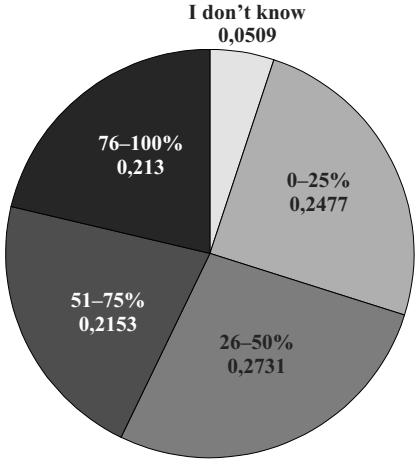

Figure 5. Expected subsidy levels to induce the respondents to replace their heat source if the total replacement cost was 40,000 PLN

Source: own study based on CATI results.

Table 4. Hypothetical subsidy statistics

	Subsidy (PLN)	
	20,000	**40,000**
Mean	9,481	20,066
Median	10,000	20,000
Mode	10,000	20,000

Source: own study based on CATI results.

If the total replacement cost was 40,000 PLN, the responses are more evenly distributed. Nearly a quarter of the respondents would like to receive a subsidy of up to 10,000 PLN, however, most expected a 26–50% subsidy. In this group, 15% expected a subsidy of 20,000 PLN, almost 22% expected more than 30,000 PLN, and a further 6% wanted the subsidy to cover all the replacement costs. More than 5% of the survey participants were unable to specify the optimal subsidy amount. It should be noted that if the subsidy covered up to 25% of the costs, only a quarter of those surveyed would consider replacing their heat source, whereas if the subsidy increased to 50%, the interest increased to 27%. Upping the subsidy to 75% resulted in another increase, this

time of 21%. A further 21% of the respondents would consider replacement if the subsidy level was increased to 100%. Accordingly, it is possible to conclude that the level of subsidy affects the willingness to replace the heat source: the higher the proposed subsidy, the more people are willing to switch to another, more environmentally-friendly heat source.

Comparison of research results with the existing knowledge in the literature

A number of authors attempted to estimate the percentage of households interested in replacing their heat source. In a study conducted among residents of single-family houses by Pytliński et al. (2021), as many as 48.2% stated that they had no plans in this regard. Switching to gas was considered by the second-largest group (17.4%), followed by coal-fired boilers (8.6%), pellet boilers (8.3%), heat pumps (5.4%), and electricity (3.7%). In contrast, according to another, slightly less recent study, as many as 78% of those surveyed stated that they did not intend to replace their heat source in the near future, fewer than 12% only wanted to replace their coal boiler with a more efficient one, whereas nearly 7% considered switching to gas heating. Fewer than 1% of the respondents stated that they planned to switch to environmentally-friendly sources, such as heat pumps (Zaborowski & Walczak, 2018). The authors of the cited study also inquired about a five-year perspective – if boilers had to be replaced due to poor air quality – and found that more than 47% of the respondents would be able to do so within this time frame if the cost did not exceed 8,000 PLN (Zaborowski & Walczak, 2018). A very similar response structure was reported in a survey of occupants of single-family houses in the Małopolska region, where more than 77% of the respondents declared that they were not planning to replace their coal boilers, more than 10% showed interest in switching to gas, whereas 7% intended to upgrade their old gas boilers. In the cited survey, ecological heat sources were chosen by fewer than 2% of the participants (Pytliński, 2016). By contrast, in our survey, approximately 23% of the respondents declared that they had no plans to replace their heat source, switching to gas was planned by 22% of the respondents, whereas as many as 20% chose heat pumps. Despite the varying responses and percentage breakdowns, a number of conclusions can be drawn from all of the preceding studies.

First, popular awareness of the importance of air quality is increasing (Białynicki-Birula et al., 2022; CBOS, 2019, 2021). As a result, it appears that the more recent the research, the greater the interest in heat pumps and, more broadly, heat source replacement. Environmental awareness aside, the existing support programmes and anti-smog resolutions may affect people's willingness to replace/upgrade or even trigger the entire process. It is worth noting that the proportion of the respondents who chose heat pumps is higher in the study reported in this paper than in research published two years ago (Pytliński et al., 2021), which may be due to the fact that the said programmes (such as Clean Air) have been in place long enough to be noticed.

Second, a sizeable proportion of the respondents in each of the discussed studies were considering switching to gas heating. It would be interesting to repeat these surveys in the current situation, i.e. after the outbreak of war in Ukraine, to see if these figures have decreased. Another intriguing finding is that a subset of participants in each study preferred to continue using solid fuels for heating, even though they were willing to upgrade their current appliance to a more efficient one.

Our research also uncovered a number of factors that discourage people from replacing their current heat source, with financial concerns playing a major role. Nearly two-thirds of the respondents felt that the proposed subsidy levels were insufficient. The existing literature implies that subsidies have a significant impact on people's decisions in this respect. With a subsidy

of 30%, 46% of those surveyed would be willing to replace their heat source, with a 50% subsidy the number increases by 13%, while a 70% subsidy adds another 12% to the pool (Pytliński, 2016). Aside from purely financial factors, the lack of knowledge, the complexity of the installation process, and bureaucratic constraints all have a negative impact on willingness to upgrade.

A number of studies deal with factors that affect people's willingness to pay extra for green electricity (Hojnik et al., 2021; Kowalska-Pyzalska, 2019; Mamica, 2021; Zorić & Hrovatin, 2012) or clean air (Dong & Zeng, 2018; Guo et al., 2020). They all emphasise the importance of environmental awareness and attitudes as determinants of willingness to contribute to the costs of energy transition (Kowalska, 2020). This relationship is also supported by our research, but in the context of upgrading heat sources. Furthermore, our findings suggest that people living in older houses are more inclined to replace their heat sources, which, according to the authors of this paper, may be due to higher heating bills caused by the poor performance of current thermal insulation. However, in order to confirm this hypothesis, additional research would need to consider a variety of energy efficiency improvements in this specific segment of the housing stock.

In view of the foregoing, the authors of this paper believe that priority should be given to:

- adjusting subsidy levels in support programmes to current prices (i.e. taking inflation into account),
- removing bureaucratic obstacles,
- promoting RES and expanding knowledge of their positive impact on the environment,
- promoting support programmes so that as many people as possible are aware of their existence.

Conclusions

Low stack emissions are unquestionably a serious issue that must be addressed effectively, particularly in view of recent decisions to extend the deadlines for phasing out all coal-fired heating systems, which will likely have a significant impact on air quality during the current heating season, including in the Małopolska region. Concerns about what would be burned in boilers this winter have long been a media topic, as researchers discover more and more links between air pollution and declining health (Kowalska, 2020; Traczyk & Gruszecka-Kosowska, 2020; Zieliński et al., 2018).

In Poland, households that use solid fuel (especially coal) for heating purposes are primarily responsible for low stack emissions. In order to solve or mitigate the severity of this problem (as well as issues with coal supply caused by restrictions on imports from Russia), it is critical to replace the old and inefficient coal boilers with heating systems based on heat pumps or electric boilers. To accomplish this, support programmes must be tailored to the needs and expectations of those who continue to use solid fuels; moreover, increased public awareness initiatives about energy efficiency and air quality are required. In-depth knowledge of potential heat sources and how they work should be disseminated more broadly. The analysis of a representative group of single-family house occupants reported above allows important conclusions about current heating systems and preferences for change to be drawn. The most important findings that correspond to the research questions and hypotheses presented in this paper are as follows:

Almost 80% of the respondents expressed interest in replacing their heat source. Approximately 60% of them want to upgrade their current boiler, but prefer to continue using solid fuels. Heat pumps and electric heating proved to be the least popular, whereas gas boilers and pellet boilers were the most common alternatives. However, switching from coal to gas or increasing the use of pellets should result in a significant reduction in low stack emissions per household.

According to logit regression analysis, the following factors influence people's willingness to replace boilers: the age of the house, environmental awareness, and knowledge of renewable energy and heat sources. The strongest correlations were found among those respondents who declared a high level of environmental awareness. Those who were more familiar with renewable energy sources and lived in older buildings were also more likely to consider upgrading their heating systems (as the current ones are likely to generate high bills). The other variables studied, such as gender, the respondents' age, employment status, and educational level, proved to be statistically-insignificant.

The high costs of purchasing a new appliance, little or no subsidy, and the fear of rising bills are the main deterrents to replacing a solid fuel boiler. The respondents frequently mentioned all of these, which means that financial factors constitute the most significant impediment to heating transition in Poland. Other barriers include a lack of familiarity with full purchase and operating costs, a complicated installation process, a failure to adapt the home to the needs of ecological heating, and a fear that the new heat source will not provide full thermal comfort. The final factor of note was the complexity of the subsidy application process. Knowledge-related issues should thus be recognised as another significant obstacle.

The expected subsidy levels are comparable regardless of the purported cost of the new appliance. A 50% subsidy towards replacement costs is most commonly expected based on the median and the dominant; likewise, only about 5% of those surveyed in both cases are unable to specify the level of subsidy that would encourage them to switch from a solid fuel boiler. In the less expensive scenario, approximately 14% of those surveyed expect a subsidy of 76–100%, whereas in the more expensive one, the percentage of those anticipating the highest possible subsidy rises to over 21%. According to the findings, the higher the subsidy, the more people are willing to replace their heat source. In both the examined scenarios (i.e. 20,000/40,000 PLN), each increase in subsidy results in more people expressing interest in replacing their heat source.

The analysis contained in this paper presents general conclusions, without taking into account the specific needs of people in a difficult financial situation. Future research should focus on separating those who are energy-poor from those who can afford to replace their heat source but for various reasons do not.

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Agata Krukowska-Miler

Vaccination Management in the Republic of Poland and in Selected Countries

Abstract

Objectives: The aim is to look at the vaccination management process, which may lead to its improvement. The article focuses on the analysis of management activities in healthcare, the vaccination process, and its impact on the development of the pandemic. It will show not only information about the pandemic, but, most of all, the impact of actions on the spread of the disease compared to other countries at different times.

Research Design & Methods: The main research method includes a critical analysis of secondary data. The study covers the period from January to April, 2021.

Findings: Operating in a situation where raw materials (vaccines) are of a limited availability and the social and economic situation is difficult (pandemic) poses challenges. This situation is completely new to the whole world and as such requires a new perspective on the problem. The thesis that good management contributes to the improvement of a given process is confirmed.

Implications/Recommendations: Secondary research, illustrating the course of the vaccination process in various countries, has shown that it is possible to create an optimal vaccine management method only by taking into account the elements that make up the socio-cultural and political factors.

Contribution/Value Added: The hypothesis in this article was based on the statement that there is an optimal crisis management based on the experiences of different countries and the meeting of their different methods of organising vaccination against SARS-CoV-2. From the point of view of economic sciences, it is a novel topic, because, for the first time. it is possible to examine the relationship between health policy and the state of a global epidemic in the era of general access to information, fast data transfer, high mobility, and globalisation.

Keywords: pandemic; vaccination process; management; COVID-19

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Introduction

The COVID-19 epidemic began in China, Hubei Province, Wuhan City on November 17, 2019, and spread worldwide (WHO, 2020a). On March 11, 2020, it was declared a pandemic by the World Health Organization (WHO, 2020b). Infections with the SARS-CoV-2 virus were recorded in Poland since March 4, 2020 (Ministry of Health, 2020). On March 13, the WHO announced that Europe was considered the epicentre of the coronavirus pandemic (Puls Medycyny, 2020). Patients were registered on all continents except Antarctica.

In the period from March 14 to 20, 2020, an epidemic threat was in force in Poland, and from March 15, a sanitary cordon was introduced on the Polish borders, significantly limiting border traffic. According to the regulation of the Minister of Health, an epidemic was in force in Poland since March 20. It is connected with a number of restrictions both for citizens and entrepreneurs, cultural institutions, sports, science, and higher education. These restrictions are introduced or repealed depending on the epidemic situation in a country. The pandemic hit all areas of human activity. Countries and the WHO both indicate mass vaccination as the only effective fight against the virus (May 2021). The following SARS-CoV-2 vaccines are currently available worldwide.

In December 2020 and January 2021, BioNTech, Pfizer (December 21), Moderna (January 6), and AstraZeneca (January 29) were granted a conditional marketing authorisation based on a positive safety, quality, and efficacy assessment by the European Medicines Agency (EMA) (European Commission, n.d.).

Vaccines by both Pfizer and Moderna are genetic and based on mRNA material. "In genetic vaccines, one or more genes of the virus are used to trigger an immune response in the body. This means that there is genetic information in the preparation, in this case, in the structure of a protein on the spines of the virus, which causes the cells to start producing this protein. It is recognised by the body as 'foreign', which results in the production of the appropriate antibodies" (Ważna & Mikołajska, 2021).

The Astra-Zeneca (new name: Vaxzevria) and Johnson & Johnson are vector vaccines that rely on the use of fragments of other viruses to elicit an immune response against a specific virus. Like genetic vaccines, vector vaccines are a relatively new technology. They have already been extensively studied in research on HIV and other diseases, such as the Ebola virus (Ważna & Mikołajska, 2021).

On March 11, 2021, the European Medicines Agency (EMA) issued a positive opinion on the vaccine from Janssen Pharmaceutica, which is part of Johnson & Johnson. The preparation has been approved for use in the European Union countries. It is a single-dose vector vaccine and its delivery in Poland was expected in the second half of April, 2021. There are also vaccines not approved for vaccination in Poland and the EU. These are: the Sputnik V vector vaccine; recombinant protein vaccines, which contain the purified SARS-CoV-2 S (spike) protein or a protein fragment (Ministry of Health, 2021). Advanced research is also carried out with regard to: the Novavax recombinant adjuvanted vaccine and the Sanofi-GSK recombinant adjuvanted vaccine.

The European Medicines Agency is conducting a rolling review of three COVID-19 vaccines: the Novavax recombinant protein vaccine (NVX-CoV2373) (staged procedure from February 3, 2021); the CurVac AG (CVnCoV) mRNA vaccine (staged procedure from February 12, 2021); and the Sputnik V vector vaccine (Gam-COVID-Vac) (staged procedure from March 04, 2021) (Ministry of Health, 2021).

Managing decisions related to the SARS-CoV-2 pandemic

The introduction of the vaccination process in the countries of the European Union and globally is subject to a management process. The management principles enable the optimisation of the taken actions and the control over the entire process. Process management is an activity that consists of optimising the structure of organisational elements due to their impact on creating the value of the final effect of the separated processes. It is an attempt to maximise positive value elements in the structure, i.e. process components, and at the same time to minimise ineffective operations (Grajewski, 2007). More broadly, the entire vaccination process can be considered as a management process, of which the state is the lead organisation in this case. According to the definition, management is a set of activities (including planning and making decisions, organising, leading, i.e. managing people, and controlling) directed at the resources of the organisation (human, financial, material, and information) and carried out with the intention of achieving the organisation's goals in an efficient and effective way (Griffin, 2005). In this case, the organisation is the state and the resources to be protected are the citizens who ultimately contribute to the smooth functioning of that state (Regulation of the Prime Minister of April 11, 2011 on the organisation and operation of the Government Center for Security; Journal of Laws of 2015, item 508).

Other definitions of management emphasise the action of disposing resources, because people constitute the most important resource, and money is a resource, and, thus, people are affected. Management is associated with leadership, and the phrases 'organisation and management' as well as 'leadership and management' are very often used together (Pszczołowski, 1978). It is an activity aimed at causing the functioning of entities, organisations, or subordinates, in accordance with the goals of the manager (Gliński, 1974).

Management consists of providing (consciously creating) conditions for the organisation to operate in line with its assumptions, i.e. to carry out its mission, achieve goals consistent with it, and maintain the necessary level of consistency enabling survival (i.e. isolation from the environment) and development (i.e. implementation of the mission and goals in the future) (Koźmiński & Jamielniak, 2011). The basic management functions include: planning; organising; motivating; control (Stoner, 1992; Mintzberg, 1973; Lamond, 2004).

For pandemic vaccine management, we may consider crisis management. Studies on Poland in this regard can be found, among others, in:

- The Act of April 26, 2007 on crisis management (Journal of Laws of 2017, item 209);
- The Act of April 18, 2002 on the state of natural disaster (Journal of Laws of 2017, item 1897);
- Regulation of the Prime Minister of April 11, 2011, on the organisation and operation of the Government Centre for Security (Journal of Laws of 2015, item 508);
- Regulation No. 67 of the Prime Minister of October 15, 2014, on the organisation and operation of the Government Crisis Management Team (MP of 2014, item 926);
- The Act of March 8, 1990, on neighbourhood self-government (Journal of Laws of 2017, item 1875);
- The Act of June 5, 1998, on district self-government (Journal of Laws of 2016, item 814 as amended);
- The Act of June 5, 1998, on provincial self-government (Journal of Laws of 2016, item 814 as amended);

– The Act of September 8, 2006, on the State Medical Rescue (Journal of Laws of 2016, item 1868);
– The Act of January 23, 2009, on the voivode and government administration in the province (Journal of Laws of 2015, item 525);
– The Act of November 22, 2013, on the emergency notification system (Journal of Laws of 2013, item 1635 as amended).

Crisis management concerns both controlling and overcoming a crisis situation, as well as preparing for its possible occurrence. Crisis management is discussed, among others, by K. Holla, J. Ristvej, M. Titko, (2018), S. Kovoor-Misra S. (2019), J. Ziarko (2010). Considering potential emergencies usually prevents them, or at least reduces their adverse effects (Hayes, 2021). The actions to be taken in a crisis situation partly overlap with the actions customarily taken in management. The actions to be taken include:
– the appointment of an anti-crisis team;
– the establishment of communication and information methods;
– range limitation;
– the elimination of the threat;
– the restoration of normal functioning;
– the long-term liquidation of the effects of the crisis;
– lessons for the future.

Materials and methods

This study uses a comparative analysis based on secondary data with the aim of confronting the actions that individual countries are taking to ensure epidemic safety for their citizens by providing them with the possibility of vaccination against SARS-CoV-2.

The hypothesis assumes that the better the rules governing the vaccination process are, the more efficient the process is. Among the studied countries, particular emphasis was placed on anti-crisis measures in Poland against the background of other EU states such as Spain and Germany, and non-EU countries such as the United Kingdom, Israel, and the United States of America. All these of them belong to highly-developed countries that do not have major economic problems with financing the purchase of vaccines. Also, all of them have a well-developed healthcare system. Seven countries were selected for this study, representing different approaches to vaccine management in the pandemic era. These are: Poland, Germany, Spain, the United Kingdom, the USA, Israel, and Brazil. The first three, despite their presence in the structure of the European Union, take various steps to increase security. Poland is a country where crisis and vaccination are managed in an inconsistent and uncoordinated manner. Germany is the opposite, because the vaccination process there is progressing in a coordinated manner despite relatively strong anti-vaccination movements. Spain is the country where resistance to vaccination is the lowest, but human relations are strong. The UK is a liberal country in which it is very difficult to ensure compliance with restrictions. Also, social resistance to vaccination is the strongest there. The same is true in the case of the USA, which only changed its vaccine management policy after Biden had become the president. Israel is the country that quickly lifted the restrictions due to an efficient mass vaccination management system and very small anti-vaccination movements. Brazil, which ends the ranking, is an example of a less-developed country in which the failure of the vaccination process is additionally determined by the country's rulers who are sceptical about richer countries.

This comparison provides a picture of the difficulties involved in managing the vaccination process in a pandemic era. This picture shows different paths and makes it possible not only to compare them, but also choose the optimal way out of the pandemic crisis for different countries.

Results

It must be said that the distribution of vaccines is not proportional and depends on the wealth of the affected country. For this reason, the COVAX programme (COVID-19 Vaccines Global Access) was implemented. However, more affluent nations have entered into national bilateral agreements with vaccine manufacturers. Last year, 56 such contracts were concluded (Puls Medycyny, 2021), which hinders the implementation of the COVAX programme, which aims to ensure fair distribution of the vaccine around the world. This programme was launched in February 2021; 190 countries have joined the WHO's initiative, the GAVI Global Vaccine Alliance, and the Coalition for Epidemic Preparedness Innovation (CEPI), half of which are paying countries. The programme is expected to enable the purchase of 2 billion doses of COVID-19 vaccines by the end of 2021. These vaccines are to be distributed to 92 poorer countries around the world (Polityka Zdrowotna, 2021a). Only the European Union allocated 500 million EUR to COVAX, and some EU countries also paid additional money. The graphs below include data on people who have received at least one dose of the COVID-19 vaccine in a given country, i.e. the adopted vaccination policy in the world (Our World in Data, 2021).

When analysing Figure 1 and 2, the following aspects can be noted. The analysed data shows that the USA was the first to start vaccinating. On 11 December, 2020, the Agency for the Food and Drug Administration (FDA) approved the COVID-19 vaccine developed by Pfizer and BioNTech for emergency use. On December 14, the vaccination process began in the USA (Mikołajska, 2020).

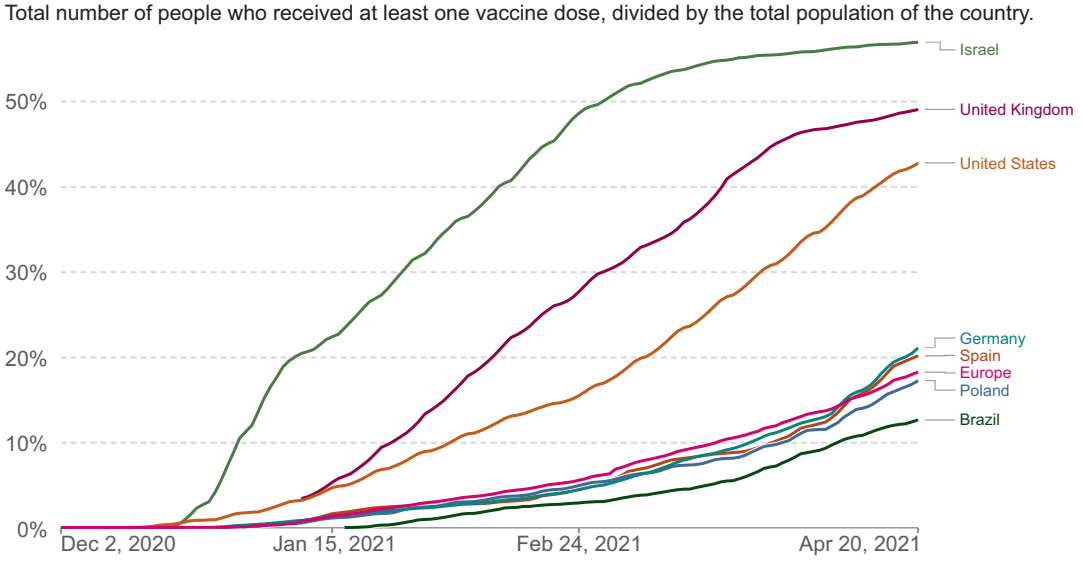

Figure 1. Share of people who received at least one dose of COVID-19 vaccine

Source: Our World in Data (2021).

Policies for vaccine delivery. Vulnerable groups include key workers, the clinically vulnerable, and the elderly. "Others" include select broad groups, such as by age.

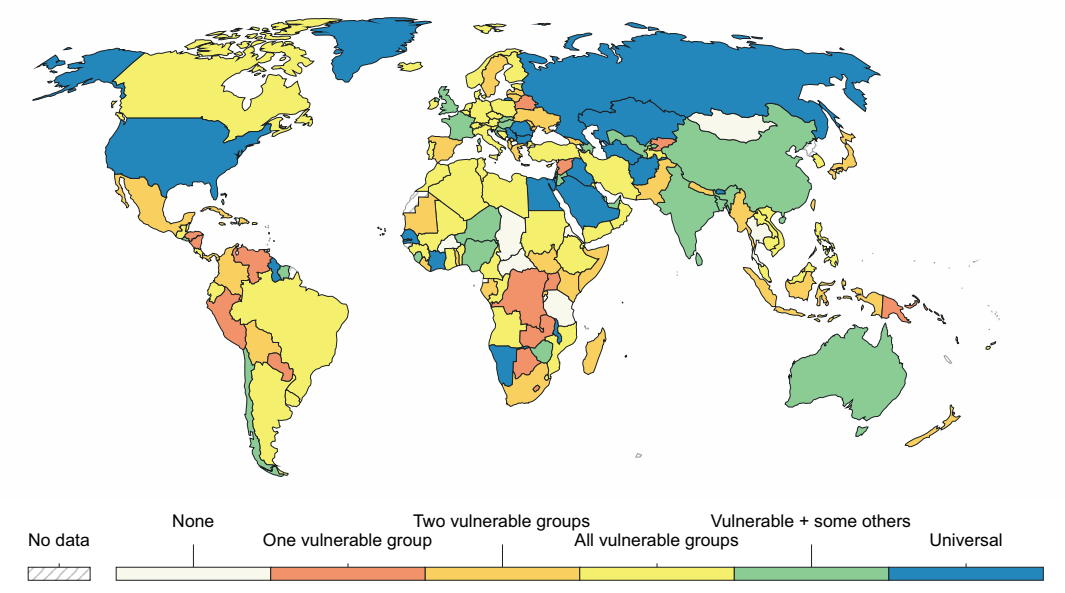

Figure 2. COVID-10 Vaccination Policy

Source: Our World in Data (2021).

Both federal and state governments are responsible for the distribution of vaccines in the USA. The government administration decides how many vaccines each state will get, then ships them to distribution centres. The preparation of vaccination plans and the order of administration of the preparation is the responsibility of state institutions. They are based on guidelines prepared by the Donald Trump administration. These provisions ambiguously define the priority of receiving the vaccine. Health institutions are not able to handle large numbers of patients. The very process of registering for vaccinations is slow due to overloaded websites and constantly busy telephone lines through which appointments are made. Organisational errors, combined with unclear guidelines, are causing too many vaccines to be delivered to some parts of the country, while other states are experiencing shortages of supplies.

This situation gave rise to 'vaccine tourism' in the USA. Visitors to the New York City as well as Florida vacation home owners go to these states not as tourists, but in order to get the vaccine in advance. Another problem is the reluctance to vaccinate. Statistics from New York show that while white residents in the city have taken nearly half of the vaccines available, the numbers among black and Latin Americans are 11% and 15%, respectively. This is due to the lack of Spanish-speaking volunteers who would assist Hispanic seniors with vaccination registration (Naftulin & Attkar, 2021). The situation changed completely after Joe Biden had started the presidency, as he considers vaccination to be a priority action.

The situation is different in Israel, a country that is a leader in terms of the number of vaccinations, which began on December 19, 2020 (Forsal, 2021). Israel has a system to fully monitor the vaccination process through a customised digital citizen vaccination record and one unique identifier used in all healthcare facilities to keep data on doses and the number of vaccinations on

a day-to-day basis. The registry also enables the monitoring and evaluation of post-vaccination side effects and provides real data on vaccine efficacy. Israel has a large body of well-trained nurses who are authorised to administer vaccinations without the presence of doctors. Israel also acted swiftly to change the laws governing paramedics' practice so that they, too, could administer vaccines (MEDEXPRESS, 2021).

In July 2021, a special law came into force, allowing services to track citizens' mobile phones. The act did not came across very well. People were so scared of the virus that they thought it was better for the services to know where they were. A similar attitude concerned the government application, which also tracked the whereabouts and sent notifications in a situation where contact with an infected person could have occurred. The app was not mandatory, but Israelis were eager to install it anyway. Moreover, owing to trust in the State of Israel, the country is the world leader in terms of vaccination rate. More than 55% of the public have already received one dose of the vaccine, and more than 50% have received both doses.

The problem in this country only appeared in the group of ultra-orthodox religious followers, but even here the rabbis allowed them to vaccinate (Krämer, 2021). Health experts cite the relatively small size of the country, with a population of only about 9 million, as the reason for rapid nationwide immunisation in Israel. Every Israeli citizen must be a member of one of the four health insurance companies that run their own clinics. The vaccination campaign is conducted by these units as well as by hospitals and specially-created vaccination centres, seven days a week. Here, too, people over 60, medical staff, and careers, as well as people at risk, were vaccinated first.

The situation is different in the Gaza Strip and the West Bank, which is administered by the Palestinian Authority, and where infection rates have increased. There is no vaccination schedule there. The Palestinian Authority focuses primarily on participation in a special programme of the World Health Organization and the Gavi Vaccine Alliance. Owing to the COVAX programme, vaccines can be delivered there by mid-2021 (Deutsche Welle, 2020). In the countries of the European Union, the vaccination process started officially on December 27, 2020 (Krzysztofek, 2020b).

In Germany, vaccinations started earlier than planned, all owing to the decision of the management of the nursing home in Halberstadt in Saxony-Anhalt, where 101-year-old Edith Kwoizalla and approximately 40 other residents and 10 nurses were vaccinated. In Berlin, the national vaccination programme began on December 28 in one of the nursing homes. However, starting vaccination too early in one of the centres turned out to be a problem in the first days of vaccinations. Due to the breakdown in several Bavarian counties, the initiation of the vaccination had to be postponed, as there were inconsistencies in the cold chain, which are to be cleared with the manufacturer of the preparation. Similar problems arose in Upper Saxony. GPs in Germany have been dealing with coronavirus vaccinations since April 2021. Family doctors' clinics were to be supplied with vaccines through pharmaceutical wholesalers and pharmacies. At the same time, the large vaccination centres that were set up at the end of the year 2020 were still operational. According to the data of the Federal Association of Health Insurance Physicians, vaccination could be carried out in 75,000 medical clinics in Germany. If 50,000 clinics admitted 20 people every day, up to five million people could be vaccinated per week.

The Association's simulation shows that, if there are enough vaccines in Germany, all volunteers will be vaccinated by August 2021 at the latest. The head of the European Commission, Ursula von der Leyen, announced that, from April, European Union countries will receive 100 million doses of vaccines per month (Deutsche Welle, 2021a).

Germany published recommendations on vaccination sequences on December 8, 2020, through the German Standing Committee on Vaccination operating at the Robert Koch Institute. The recommendation concerned the priority of people over the age of 80, carers of the elderly and the sick, as well as employees of hospital emergency departments and COVID-19 departments. As explained by the commission, these people are at the highest risk of severe disease and even death, or, because of their work, they are at the highest risk of infection, or are in constant contact with people at risk. Nursing homes, as well as medical staff in transplantology or oncology departments, are also mentioned. In total, over 8 million people will be vaccinated in the first phase. Vaccines were also first given to people suffering from other diseases and representatives of systemically important professions, such as teachers, policemen, and firefighters (Deutsche Welle, 2021b).

In Spain, vaccinations began on December 28, 2020, in Guadalajara, where the Pfizer's logistics centre is located. On Sunday morning, a 40-year-old female worker and her 96-year-old protégé were vaccinated in a local nursing home. Other residents of the centre and staff also received the vaccine. In Spain, healthcare workers, especially hospital infectious wards, paramedics, and staff in intensive care units, were the first to be vaccinated. The next vaccinated group consisted of nursing home residents and the staff of these institutions. For over 30 years, Spain has had a law that makes it compulsory for citizens to vaccinate against COVID-19 (Mandatory Vaccination Provision). However, Pedro Sánchez's government did not take such radical steps; only a register of people who refused to participate in voluntary vaccination was introduced. The Spanish government had planned to vaccinate about 70% of the population against coronavirus by September 2021. Achieving this goal was probably difficult due to the relatively low interest in vaccination against COVID-19 in the country. According to the results of public opinion polls, about 28% of citizens do not want to be vaccinated.

In such a situation, the condition for enabling compulsory vaccinations must be the existence of a threat to public health, while the decision to introduce compulsory vaccinations is to be confirmed by the court. The Spanish government is trying unconventional methods compared to other countries to encourage citizens to get vaccinated. A special register has been set up for all those refusing to participate in vaccination. The register will include people who have been included in the vaccination programme but have not participated in it. Moreover, the data from the database will be made available to other European countries. Vaccinations in Spain are carried out by 13,000 public health facilities. There is a national immunisation programme there. First of all, it was available to healthcare workers, and then, *inter alia*, to the residents of nursing homes. Approximately 2.5 million people were expected to receive the vaccine during the first phase of vaccinations. People who have recovered from COVID-19 are to be vaccinated last (Krzysztofek, 2020).

Vaccination in Poland began on December 28, 2020. It is up to national governments to develop vaccination plans, but there is a general tendency to vaccinate healthcare professionals and the elderly at the outset, i.e. groups at the highest risk of severe cases of COVID-19. In Poland, as well as in other EU countries, the vaccine is free and voluntary. Vaccinations are first targeted at those most vulnerable to infection. The division took place into groups (I, II), and now there is a tendency to release vaccination dates. Earlier restrictions were due to problems with the availability of vaccines (Krzysztofek, 2020).

The average rate of vaccination per day is at the level of 200,000, but about 1.5% of scheduled patients fail to attend the scheduled date (Ministry of Health, 2021). On April 19, 2021, the first universal vaccination point against COVID-19 was launched in Poland, and with it, 16 similar

points as part of the pilot programme. The government assumed that if mass vaccinations were launched in May, all Poles who wanted to be vaccinated would receive the first dose by the end of August (Interia, 2021; Bieńczak & Markiewicz, 2021). Poland reported long delays in the supply of individual vaccines, causing delays related to the vaccines themselves. There is also a phenomenon of blocking vaccination sites by the so-called 'anti-vaxxers', who do not show up for vaccinations (Polityka Zdrowotna, 2021b).

In the UK, vaccinations have been available from 8 December, 2020. The British are not obliged by EU decisions, because they are no longer a member state. The British organised the mass vaccination programme in an almost exemplary fashion and kept strict restrictions for a long time. They also approached the dosage quickly and, initially, differently than others, and delayed the administration of the second dose of the COVID-19 vaccine so as to give the first dose as soon as possible to the largest group of people at the highest risk of severe disease and death. The UK ordered over 400 million doses of seven of the most promising vaccines. In the UK, three brands are used: AstraZeneca, Pfizer, and Moderna. AstraZeneca is produced in several factories in the United Kingdom, hence a certain independence from vaccine supplies. The next doses were to come from the Serum Institute of India and the Halix plant in the Dutch city of Leiden. The Pfizer's vaccine is imported to the UK from a factory in Puurs, Belgium, and Moderna doses come from factories in Switzerland and Spain, and are also shipped from Belgium (Bellon, 2021).

According to the plans, by April 15, 2021, all nine priority groups, i.e. 32 million people, were to be vaccinated. According to the statistics from Our World in Data, which tracks vaccination progress, the number of doses administered in the UK per 100 people was, at the time of writing this article, 39.04. In the USA, it was 33.11, and in the European Union, it was 11.81 (Gazeta Prawna, 2021).

From September 2020, the most vulnerable and oldest British citizens were to receive a third dose of the COVID-19 vaccine, which was expected to offer better protection against new variants of the coronavirus. The next boosting dose was to be given first to people over the age of 70, healthcare workers, and social workers, as Zahawi told the newspaper in an interview published on Saturday. People up to 30 years of age could decide whether they preferred the Pfizer or Moderna vaccine (Onet, 2021).

For comparison, the vaccination process in Brazil is presented. Brazil is a less-developed country and there are insufficient resources to look after the entire society. It is one of the most affected countries in the world. In terms of mortality, it is the second country in the world after the USA (at the moment, i.e. April 4, 2021, the worst situation is India). To date, more than 12.3 million cases of infection have been confirmed, and 303,000 Brazilians have died. Thursday (04.04.2021) was record-breaking in terms of infections, which were recorded at the level of over 100.1 thousand (Medonet, 2021).

Vaccination with the Chinese Sinovac Biotech vaccine and the AstraZeneca vaccine started in Brazil. On January 29, 2021, they were approved for use by the Anvisa Brazilian drug control agency (Stasiński, 2021). In Brazil, the country's first COVID-19 vaccine, ButanVac, was produced at the Butantan Institute in Sao Paulo. The new formula was supposed to enter into use in the first half of 2021. It will initially be produced only in Brazil, where vaccination against SARS-CoV-2 is carried out by several foreign products, mainly from China. So far, more than 30 million doses of coronavirus vaccines have been delivered to Brazilian states. Among the 15 million already vaccinated citizens, more than 11 million are those who took the first dose. Brazil's problem involves the lack of a consistent government policy, and the Brazilian President Jair Bolsonaro

said that the rush to vaccinate against COVID-19 is unjustified. He also criticised pharmaceutical companies and announced that he would not undergo vaccination.

Bolsonaro is one of those who question the severity of the pandemic and criticise any restrictions on social contact to limit it. Still, the president signed an executive decree that allows the government to incur a debt of 20 billion *reais* (about 4 billion USD) to purchase vaccines against COVID-19. The Ministry of Health also announced the main assumptions of the vaccination campaign. It assumes, *inter alia*, immunising everyone, i.e. 210 million inhabitants of the largest country in Latin America, within 16 months (Gazeta Prawna, 2021).

Brazil had one of the largest coronavirus outbreaks in the world: it had the second highest number of daily deaths (964) and the third highest number of new daily infections (54,000). More than 200,000 Brazilians have already died from the coronavirus, and more than 8.5 million have become ill. The governor of Sao Paulo was the first to bring the (Chinese) vaccine to Brazil. It is also his personal triumph, as the vaccine is now also produced by the Brazilian company Butanan. As of April 2021, the company had 6 million doses of the vaccine ready in Sao Paulo, but could not distribute them around the country due to the lack of government approval. Paradoxically, President Bolsonaro tried to block the production and legalisation of the vaccine. The president himself announced that he would not get vaccinated, and he advised his compatriots to use an anti-malaria drug, chloroquine, which is not recommended by Brazilian medics and scientists, or by the World Health Organization. First, doctors and healthcare professionals were vaccinated, then the transport of vaccines to the most affected areas of the country began. The Butanan company announced that it would be able to produce 46 million doses of Coronovac by April, 2021. The federal government was unable to deal with the distribution of vaccines (Stasiński, 2021).

Table 1 shows that the most important factors lie in two areas: socio-cultural and political. In details, it can be assumed that the socio-cultural area focuses on elements such as: social discipline, the strength of anti-vaccine movements, trust in the State, confidence in promotional campaigns and the State's communication policy. In the political area, the most important elements are as follows:

– the organisation of vaccinations from the practical side (the availability of vaccines, deliveries, the organisation of a network of points);
– affiliation with international organisations;
– authorities' attitude to science and to the pandemic;
– organisations and recommendations of age, and social groups for vaccination;
– campaigns promoting vaccination at the central level;
– the centralisation or decentralisation of vaccination activities.

All these elements and factors influence the speed of controlling the epidemic situation and the advancement of the vaccination process until collective immunity is achieved, and, as a result, overcoming the epidemic and normalising the social and economic life.

Table 1. Management of the vaccination process in selected countries

Factor	Poland	Germany	Spain	UK	US	Israel	Brazil
Start of vaccination	28/12/20	26/12/20	28/12/20	8/12/2020	14/12/20	19.12.20	29.01.21
Supervision	State	State/ Landes	State	State	Individual states/ country	State/ accurate record system	Local Government
Is there a programme recommending people to get vaccinated?	Yes	Yes	Yes	Yes	Yes	Yes	No clear guidelines
Epidemic situation	Controlled	Controlled	Controlled	Controlled	Controlled	Very good	Very bad
Access to vaccines – production/ distribution	Import	Own	Import	Own	Own	Import	Own
Power of anti-vaccine movements	Mean	Mean	Small	Mean	High	Very small	High
Population vaccinated with 2 doses	10,1%	10%	13.9%	27,7%	35.8%	56.2%	7,5%
Falling ill with COVID-19	4159 (12/5/21)	7321 (10/5/21	6428 (12/5/21)	2357 (10/5/21)	33789 (8/5/21)	(5/5/21) 68	76,692 (10/5/21)
Total population	37,660,000 (2021)	82,186,000 (2021)	46,468,000 (2021)	67,082,000 (2021)	335,190,000 (2021)	9216,000 (2021)	215,278,000 (2021)

Source: Own study based on Mathieu, Ritchie, Ortiz-Ospina *et al.* (2021).

Conclusions

Based on secondary research, the most important factors influencing the course and management of the vaccination process can be determined. The hypothesis in this article was based on the statement that there is an optimal crisis management based on the experiences of different countries and the meeting of their different methods of organising vaccination against SARS-CoV-2. From the point of view of economic sciences, it is a novel topic, because, for the first time. it is possible to examine the relationship between health policy and the state of a global epidemic in the era of general access to information, fast data transfer, high mobility, and globalisation. The hypothesis relies on the statement that there is an optimal crisis management based on the experiences of different countries and the meeting of their different methods of organising vaccination against SARS-CoV-2.

Secondary research, illustrating the course of the vaccination process in various countries, has shown that it is possible to create an optimal vaccine management method only by taking into account the elements that make up the socio-cultural and political factors. A detailed analysis has shown that the effectiveness of the vaccination process during a pandemic does not directly depend on the availability of vaccines. The example of vaccination in Israel shows that it does not matter whether the vaccine is imported or produced in a given country. As long as it facilitates

distribution and makes it independent, with the proper organisation of deliveries, the influence of this factor can be minimised.

Among the socio-cultural elements influencing the course of the vaccination process, social discipline and the power of anti-vaccination movements come first. In Israel, the impact of anti-vaccination movements has been minimised to almost zero, but in the USA and developed countries, through the Internet, the strength of anti-vaccination movements is strong. This creates a situation where many people have not come for vaccinations. This, in turn, disrupts the vaccination process and causes the still-relatively-low vaccination rates against the virus. Another element is the lack of trust in the State, manifested in the dissemination of – and belief in – conspiracy theories about the impact of politicians and the richest people on the pandemic, the belief that the epidemic is false, and that the purpose of vaccination is surveillance or even extermination. As in the previous example, where the State applied strict rules, the vaccination process was more efficient and the society recovered faster from pandemic restrictions.

The lack of trust in the State is also associated with the lack of trust in promotional campaigns. This has its roots in a general reluctance to advertising and marketing. The more the vaccination process is promoted, the greater the fears that the goal of this promotion is not to overcome the pandemic itself. All of the above should be reflected in the communication policy which would be strictly adapted to the target audience. In this aspect, it is worth considering a less formal way of persuading people to vaccinate.

Political factors include, primarily, the country's membership in international organisations. Research shows that this affiliation does not guarantee an efficient vaccination process; it only facilitates control over the process and protects political interests. An extremely important element that influences the vaccination process is attitude to science. The attitude of the President of Brazil has had a negative impact not only on the vaccination process, but, above all, on the uncontrolled development of the pandemic in this country. The lack of guidelines related to the process of restrictions (and then vaccinations) caused the virus to mutate and become more and more dangerous.

Age recommendations in the vaccination process were the first step in recommending patients and victims of the pandemic. The organisation of this process in the countries of the European Union was similar. While the majority of countries countries introduced formal recommendations, in practice, the age recommendation did not exist in the USA and Israel. In Israel, the emphasis was on mass vaccination, and in the USA, the recommendation system was ambiguous. On the other hand, in Poland, the dates of recommendations were variable, which gave the impression of chaos in the vaccination process.

Vaccination promotional campaigns appeared along with the emergence of vaccines. Their main goal was to achieve collective immunity in specific age groups. In this case, age recommendations were a problem, which in many countries made it impossible to vaccinate against one's own will. Promotional campaigns include not only commercials on TV or lotteries for the vaccinated, but also promises of freedom of movement, free holidays, or minimising restrictions. Even so, the persuasion towards vaccines in many countries has not worked entirely. As a result of the research, it can be said that the optimal vaccination process should involve the following:

– communication policy adjusted in terms of information and organisation to target recipients;
– limiting the impact of anti-vaccination movements through constant education adapted to the age of the recipients;

– strengthening confidence in the State through honest information and relative stability of rules in the face of a pandemic and the attitude of politicians;
– the constancy of the rules of the vaccination process and appropriate information policy at the individual level;
– ensuring the stability and quantity of vaccine supplies according to the size of the centres;
– introducing age recommendations, but also making it possible to vaccinate other groups at the same time while maintaining priority or separation at the point of vaccination;
– facilitating the vaccinated persons and a coherent information policy in this regard;
– emphasising the role of science in fighting the pandemic and the role of vaccination in this process;
– emphasising the role of vaccination in achieving normality;
– communicating problems related to vaccines in a neutral manner which does not arouse concern in the recipients.

All these elements avoid creating unnecessary divisions in society and the state in the face of the fight against the pandemic. Overcoming a pandemic is essential on the way to normality and economic development.

This study may contribute to the presentation of the problem of operating in a situation of the limited availability of raw materials (vaccines) and a difficult social and economic situation (pandemic). This situation is completely new to the whole world and requires a new perspective on the problem. The thesis that good management contributes to the improvement of a given process is confirmed once again. However, cooperation is required in every stage of the activity. This article describes only a small selection of activities related to the SARS-CoV-2 vaccination process. The study covers the period from January to April, 2021. It is based on secondary data that can be extended with primary data that significantly enrich the subject matter. Secondary data largely includes Polish-language articles available on websites. The inability to conduct direct research is related to, among others, the epidemic situation in Poland and the related restrictions, especially in the healthcare sector. Another danger and weakness of this study is that it describes a process that is still ongoing and cannot be judged from perspective. The final result of the actions is unknown. As previously mentioned, all these considerations and activities can be based on the theory of crisis management, which is widely discussed in the literature on the subject.

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Journal of Public Governance

Aims and scope

Journal of Public Governance (formerly *Zarządzanie Publiczne / Public Governance*) is a quarterly published since 2007. It is intended for experts and researchers who specialise in public issues, including political decision-makers and students. It offers a forum for debates between academics and practitioners interested not only in the theoretical foundations of public governance but also in the opportunities for its practical application. The quarterly is international in scope, which is reflected in the nature of research issues (they involve matters of interest to academic circles worldwide), the contributing authors (a significant proportion of them comes from different countries), and the composition of its Programme Board as well as the make-up of the team of reviewers (it includes international research and academic centres).

The mission of the *Journal of Public Governance* is to publish advanced theoretical and empirical research in public management, governance, public policy analysis and evaluation, public sector economy as well as strategic management, which reflects new developments in the methodology of social sciences. The editors select papers with an original theoretical background and those that discuss the results of pioneering empirical research. We are also eager to promote the interdisciplinary and comparative approaches based on qualitative, quantitative, and experimental studies that provide new insights into the construction of theoretical models along with the methodological concepts in the field of public management.

In our journal, we adopt a unique approach to specific issues inherent in the sphere of public governance. The originality of our approach consists in the selection of both research areas and research methodologies.

A significant proportion of texts published by our journal is devoted to the analysis of the mechanisms of public governance at national and regional government levels (respectively), relevant to the administrative culture predominant in Central and Eastern European countries with a particular focus on the programming, implementation, and evaluation of public policies. The texts:

a. focus on problems occurring in post-transition countries which build their own public governance institutions and mechanisms, including the sphere of good governance;
b. represent attempts at a creative transposition and adaptation of international achievements in developing original solutions in the field of public governance in post-transformation countries.

The distinguishing features of the research methodologies preferred by our journal include:

a. a strongly established interdisciplinary approach to the study of public governance, combining research and analyses in the areas of economics, political science, management, public policy, sociology, and psychology;
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