A Comparative Analysis of the Power of Selected European Countries. The Economic Determinants

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ABSTRACT

The ever-increasing need for in-depth analysis and quantification of the national power, in particular 'hard' and 'soft' power-generating factors as well as difficulties in identifying a comprehensive and effective method for scientific determination of the national power, have given rise to research in the indicated scientific issues within this article. The presented considerations aim to define the assumptions for a descriptive sub-model that would enable a comparison of Poland's power in the economic sphere (which is a component of the non-military sphere) with the power of selected European countries. The research hypothesis is that, among the variety of descriptive variables in the economic sphere of the national power, there is a subset of mutually independent variables, at the same time strongly correlated with the national power, which make it possible to define assumptions for the

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sub-model of the national power. The steps of the research procedure were carried out using the method of system analysis (multi-criteria comparative analysis) and statistical analysis. The research activities undertaken have shown that the factors that are strongly correlated with the national power in the economic area of the European countries adopted for the analysis are: *dynamics of industrial production, private sector credit flows* and *economic freedom index.* The comparative analysis carried out demonstrates that the greatest increase in the economic power in the analysed period took place in Germany (0.68). Slightly smaller growth was recorded in the Czech Republic (0.62) and Poland (0.60), while the lowest value of increase was in Romania (0.23). The conducted qualitative comparative analysis of the economic power of selected European countries allowed to conclude that the independent variables identified are crucial for the formation of the economic power of the analysed countries. At the same time, a fairly strong position of the Czech Republic and Poland in relation to the economic power of Germany was found. The performed quantification of the economic power of the European countries provides a basis for the correct determination of changes in the power distribution of political units, assessment of the power and resources held by the state.

ARTICLE INFO

*"There is not a more fragile and unstable thing
than the radiance of power not based on native forces."*
Tacitus

INTRODUCTION

Among various research approaches to determining the power of political entities, mathematical modelling has become a particularly popular and useful method. This trend is due to the fact that despite the high complexity and multiplicity of elements determining this phenomenon, it is possible to build simple models whose structure allows the researcher to quantify power and determine its character. Model methods facilitate analysis by omitting insignificant properties of a phenomenon under examination, and at the same time they represent reality accurately enough to allow an understanding of basic laws governing its development.[1] The advantage of the indicated method is also its practical aspect, i.e. the possibility to carry out experiments on a developed model, within the framework of a computer simulation – a technique "making it possible to imitate real processes, behaviours, decisions, and their results"[2] and to produce forecasts that can be successfully used in the processes of carrying out analyses and preparing expert opinions, as well as in the processes of making current and long-term (strategic) political decisions.[3] The power indicators obtained in this way "allow the researcher to determine the polarity of a system and the centres of political power in a region. They are also useful in analysing and explaining events and phenomena taking place on the international arena in the present and in the past, e.g. changes in international systems and wars. For politicians, apart from decision-making or analytical applications, such data constitute an additional source of information."[4]

1. SOME METHODOLOGICAL REMARKS

The literature on the subject indicates a variety of typologies of power-building components of a state, presented qualitatively, quantitatively, and structurally.[5] The most frequently used components include the following:

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[1] M. Orłowski, *Stulecie chaosu. Alternatywne dzieje XX wieku*, Warszawa, Wydawnictwo Naukowe i Literackie Open, 2006, p. 529.

[2] M. Sułek, *Prognozowanie i symulacja międzynarodowa*, Warszawa, Wydawnictwo Naukowe Scholar, 2010, p. 30.

[3] D. Michalik, *Modelowanie i symulacje międzynarodowego układu sił*, Toruń, Dom Wydawniczy DUET, 2012, pp. 43–44.

[4] Michalik, 'Modelowanie i symulacje międzynarodowego układu sił', p. 69.

[5] A broad classification in this respect was proposed by Rudolph J. Rummel, who identified 236 attributes of states divided into 28 categories. R. J. Rummel, 'International Pattern and Nation Profile Delineation', in: D.B. Bobrow, J.L. Schwartz (eds.), *Comput-*

the area of a state's territory, population, total GDP and GDP per capita, production of oil and natural gas, production of electricity, export volumes, technological development, the morale of society, the quality of a nation, the quality of governance and diplomacy, organizational and decision-making capabilities, the will to implement a national strategy.[6] It is easy to notice that the set of the above-mentioned power-building components is made up of both quantitative or so-called hard components, and qualitative or so-called soft components. Particular attention is paid to soft power, constituting, in the opinion of many researchers, a significant dimension of power, which translates into more and more frequent attempts to quantify it.[7] The variety of proposed indicators used to determine the power of political entities makes it necessary to select and categorize them. Power components are usually systematized within specific sectors (thematic blocks), such as economic, social or military blocks. It is also important to remember about the political sector, which plays the role of a binder, a cross-sectoral link, widely affecting all other factors located in the remaining sectors. Such an approach is justified by the nature of power, which is a multidimensional quantity consisting of both tangible and intangible components.[8] The advantage of this

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ers and the Policy–Making Community Applications to International Relations, Englewood Clifs-New Jersey, 1990, pp. 196–202.

[6] *Cf.* J.G. Stoessinger, *The Might of Nations*, New York, 1965; R. S. Cline, *The Power of Nations in the 1990s. A Strategic Assessment*, Lanham, 1994; D.S. Papp, *Contemporary International Relations, Frameworks for Understanding*, Macmillan, New York, 1984; D. Milczarek, *Geopolityczne czynniki kształtujące międzynarodową pozycję Unii Europejskiej – wyznaczniki geograficzne i ekonomiczne (część 1)*, https://www.ce.uw.edu.pl/pliki/pw/4-2001_Milczarek.pdf, (accessed 14 April 2018); D. Milczarek, *Geopolityczne czynniki kształtujące międzynarodową pozycję Unii Europejskiej – wyznaczniki militarne i społeczne (cześć 2)*, https://www.ce.uw.edu.pl/pliki/pw/1-2002_Milczarek.pdf, (accessed 14 April 2018); A. Antczak-Barzan, 'Potęga Rzeczypospolitej Polskiej w Unii Europejskiej', *Kwartalnik Bellona*, 2/2015; M. Kleinowski, 'Czynniki budujące siłę i potęgę państwa na arenie międzynarodowej', *Świat Idei i Polityki*, vol. 10, Toruń, Wydawnictwo Adam Marszałek, 2010; M. Sułek, *Podstawy potęgonomii i potęgometrii*, Kielce, 2001; D. Michalik, *Modelowanie i symulacje międzynarodowego układu sił*, Toruń, Dom Wydawniczy Duet, 2012.

[7] The importance of the "soft power" of political units is stressed, among others, by the American think-tank RAND Corporation, according to which, "softer forms of power seem more and more important in a more connected world". G.F. Treverton, S.G. Jones, Measuring National Power, RAND National Security Research Division, RAND Corporation, Santa Monica 2005, p. 9.

[8] Z. Lach, J. Skrzyp, *Geopolityka i geostrategia*, Warszawa, AON, 2007, p. 104.

type of approach is the possibility to perform an in-depth analysis within the framework of particular categories of power-building determinants, which is essential in the area of current research on the power of states. It is, therefore, necessary to construct a separate descriptive sub-model for each of the sectors mentioned above. The number of sub-models is not limited *a priori*, because with time, and the development of science and technology, new views and political theories emerge and, consequently, new factors that should be taken into account when constructing a model of state power appear.[9] It is symbolically presented in Figure 1.

FIG. 1. A MODEL OF STATE POWER
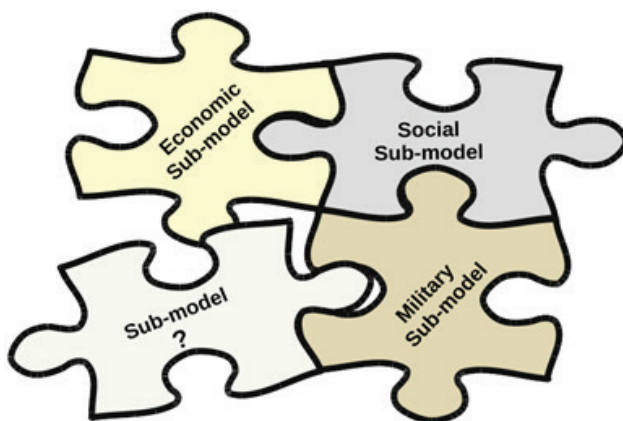
Source: Own study.

Nevertheless, an issue giving rise to numerous difficulties in research on the power of a state is the application of an appropriate methodology "acceptable to the various scientific communities and capable of producing reliable research results"[10] i.e. one that would exclude, for instance, the subjectivity of the selection of independent variables, visible in previous attempts to quantify the power of a state).[11]

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[9] Gatnar E., *Podejście wielomodelowe w zagadnieniach dyskryminacji i regresji*, Warszawa, PWN, 2008, p. 62.

[10] T. Klin, 'Możliwości zastosowania metod potęgometrii dla wybranych celów analizy geopolitycznej', *Polityka i Społeczeństwo*, no 8/2011, p. 149.

[11] D. Kondrakiewicz, *Systemy równowagi sił w stosunkach międzynarodowych*, Lublin, Wyd. UMCS, 1999, p. 58.

The development of a model of state power should be preceded by both a statistical analysis made with regard to the selection of model variables and a selection of a specific mathematical formula of a descriptive model. Both these activities are important for the quality of a constructed model and, consequently, its credibility. This means that the model should fulfil the criterion of verifiability. In reality, however, it is not always easy. It is a common practice to "impose" the form of a model, without any substantive justification of the proposed form. In such circumstances, justified doubts arise in relation to the credibility of the obtained results and the correctness of the conducted analyses. It should also be remembered that the process of analysis of a selected section of reality is often disturbed, which has an indirect impact on the final result (a model of a system under examination) Figure 2.

FIG. 2. A SYSTEMIC ANALYSIS OF A SELECTED SECTION OF REALITY
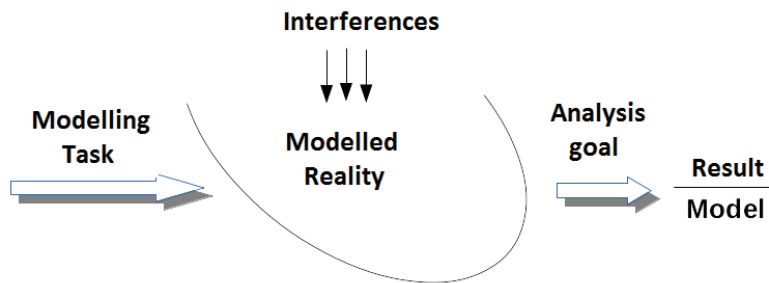
Source: Own study.

Due to the existing complexity of economic processes, the occurrence of a large number of characteristics (variables) which usually remain in mutual dependence and under strong mutual influence,[12] it is justifiable to use an econometric model in research on this issue. An econometric model of phenomena under examination is understood as "a description of a particular fragment of economic reality taking into account only its essential elements. Such a description is a kind of abstraction, and its characteristic feature is an identification of an objectively existing system of major fundamental relations occurring in the examined fragment of reality."[13]

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[12] E. Nowak, *Problem informacji w modelowaniu ekonometrycznym*, Warszawa, Państwowe Wydawnictwo Naukowe, 1990, p. 9.

[13] Z. Hellwig, *Zarys ekonometrii*, Warszawa, PWE, 1970, p. 25.

The authors attempted to analyse the power of the Republic of Poland in the non-military sphere by defining a subset of independent descriptive variables strongly correlated with the power of a state in the economic sphere. In this paper, power is understood as a relative category, while a model being a powerful cognitive tool and, above all, an effective means of solving the most complicated issues, may be any mental construct at a sufficient level of abstraction[14]. Thus, a qualitative comparative analysis of the power of selected European countries was conducted on the basis of a broad set of independent variables. The analysis involved the application of the methods of elimination of variables for descriptive models and one of the methods of multi-criteria comparative analysis, i.e. the numerical taxonomy method, also referred to as the Wrocław method. These methods make it possible to capture quantitatively significant relationships between variables, and the selection of weights for adopted indicators, carried out in the form of experimental research, allows the researcher to observe differences that occur in results generated by the model.

The authors' objective was to develop an original sub-model of state power in the economic sphere of the functioning of the Republic of Poland.

2. An economic sub-model of state power

It is not possible to examine the power of a state without first carrying out a detailed analysis of the power-building determinants of an economic nature. However, in view of the variety of descriptive variables existing in the economic sphere, it is not an easy task to make an objective and scientifically justified classification in this field. As Edward Nowak points out, "the quality of a set of explanatory variables determines the conformity of the constructed model with the reality it describes, and thus its adaptive value. The quality of a set of explanatory variables determines the reliability of the final results of econometric reasoning (…)."[15] Explanatory variables should be "strongly correlated with the variable being explained, weakly correlated with each other, and strongly correlated with other variables not selected as explanatory."[16]

In the research conducted so far on this subject, the selection of indicators was most often based on far-reaching subjectivism. Therefore, it is

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[14] J. Habr, J. Veprek, *Systemowa analiza i synteza*, Warszawa, PWE, 1976, p. 304.

[15] Nowak, 'Problem informacji', p. 24.

[16] Nowak, 'Problem informacji', pp. 44–45.

reasonable to pose the following question: How can an objective comparison of the economic components of state power be made? Taking into account the fact that the proper selection of explanatory variables is crucial for the quality of a constructed model, a statistical analysis of the figures characterizing the economic sphere of four European countries, i.e. Poland, Germany, the Czech Republic, and Romania, was conducted. As a result of the analysis, out of the 36 indicators describing the economic condition of the analysed countries, several subsets of explanatory variables were distinguished, depending on which aspect of the analysis was taken into account. Therefore, the economic power of the compared countries was assessed from various angles, in the subsequent stages of the study:

- in the first stage of the study, an intuitive analysis was performed, using the variables the most frequently exposed in the literature on the subject;
- in the second stage of the study, a model of evaluation of economic power with a preferred set of explanatory variables was constructed and the result of the performed calculations was presented.

Table 1 presents economic indicators taken into account as explanatory variables in the process of building a model of state power in the economic sphere.

TABLE 1. THE ANALYSED ECONOMIC INDICATORS

Name of indicator (unit of measure)	
x_1	GDP ($)
x_2	GDP per capita ($)
x_3	GDP per capita (purchasing power parity – $)
x_4	Energy production (Mtoe)
x_5	Energy consumption (Mtoe)
x_6	Energy consumption (kWh per capita)
x_7	Renewable energy (as % of electricity production)
x_8	Energy dependence indicator/dependence on energy imports – all products (% of net imports in gross domestic consumption and reserves) (Mtoe).
x_9	Exports of goods and services ($)
x_{10}	Length of railway lines (km)

x_{11}	Research and development expenditure (% of GDP)
x_{12}	Risk of poverty or social exclusion rate
x_{13}	Net international investment position
x_{14}	Real effective exchange rate (including deflators of harmonized consumer price index)
x_{15}	Private sector credit flows (consolidated)
x_{16}	Export market share
x_{17}	Surplus, deficit of general government
x_{18}	Current account of balance of payments – total
x_{19}	Gross domestic product growth rate (constant prices)
x_{20}	Consumer price indexes – total
x_{21}	Industrial production growth rate (constant prices)
x_{22}	Agricultural production growth rate
x_{23}	Competitiveness of economy
x_{24}	Globalization indexes
x_{25}	Economic freedom indexes
x_{26}	Unemployment rate (%)
x_{27}	Share of foreign trade in GDP (exports of goods and services)
x_{28}	Share of foreign trade in GDP (imports of goods and services)
x_{29}	Inflation (%)
x_{30}	Size of grey economy (% of GDP)
x_{31}	Crude oil production (t)
x_{32}	Crude oil trade balance (t)
x_{33}	Coal production (t)
x_{34}	Natural gas production (bcm)
x_{35}	Self-sufficiency – natural gas (calculated as the ratio of production to annual consumption)
x_{36}	Self-sufficiency – coal (calculated as the ratio of production to annual consumption)

Source: The World Bank; Global Energy Statistical Yearbook; Foreign Trade Statistical Yearbook; International Statistical Yearbooks.

2.1 An intuitive model

The correctness of the construction of two models referred to as "intuitive models" was analysed. Eight variables were used in the first of the analysed models (Table 2). The choice of a subset of explanatory variables was based on the trends observed in the literature (hence the adjective "intuitive").[17] Table 3 shows the values of Pearson's linear correlation coefficients of the pairs of all explanatory variables. It turns out that "intuitively" selected explanatory variables are characterized by a very high mutual linear correlation. This indicates unambiguously the lack of sufficient justification for their use in the current configuration in this model.

The result of a comparative analysis of the economic power of the selected states is presented in Figure 3. The obtained result shows that the model does not work properly due to the excessively lowered rating of Germany as well as the almost identical ratings of the Czech Republic and Poland.

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[17] A.M. Shinn, 'An Application of Psychophysical Scaling Techniques to the Measurement of National Power', *The Journal of Politics*, vol. 31, no. 4, November 1969; D. Ricardo, *On the Principles of Political Economy and Taxation*, London, 1817.; J.G. Stoessinger, *The Might of Nations*, New York, 1965; R. S. Cline, *The Power of Nations in the 1990s. A Strategic Assessment*, Lanham, 1994; A.F.K. Organski, *World Politics*, New York, 1967; A. Smith, *Badania nad naturą i przyczynami bogactwa narodów*, Warszawa, 1954; D. Milczarek, *Geopolityczne czynniki kształtujące międzynarodową pozycję Unii Europejskiej – wyznaczniki geograficzne i ekonomiczne (część 1)*, https://www.ce.uw.edu.pl/pliki/pw/4-2001_Milczarek.pdf, (accessed 14 April 2018); A. Antczak-Barzan, 'Potęga Rzeczypospolitej Polskiej w Unii Europejskiej', *Kwartalnik Bellona*, 2/2015; M. Sułek, *Podstawy potęgonomii i potęgometrii*, Kielce, 2001; A. Łaszczuk, 'Analiza geopolityczna potęgi państw', in: Z. Lach, J. Wendt (eds.), *Geopolityka. Elementy teorii, wybrane metody i badania*, Częstochowa , Instytut Geopolityki, 2010.

TABLE 2. THE NUMERICAL VALUES OF THE EXPLANATORY VARIABLES

	GDP X_1	GDP per capita X_2	Energy production X_4	Exports of goods and services X_{27}	Imports of goods and services X_{28}	Industrial production X_{21}	Inflation X_{29}	Size of grey economy X_{30}
Poland	469,509	12,372.4	67	42.3	43.5	104.9	1.8	25
Germany	3,466,757	41,936.1	118	46.8	41.4	101.5	1.8	13.5
Czech Republic	192,925	18,266.5	27	67.9	64.7	104.6	2.5	16.4
Romania	186,691	9,474.1	25	35.5	40.7	102.8	1.4	29.6

Source: Foreign Trade Statistical Yearbook 2015–2016, https://stat.gov.pl, (accessed 12 April 2018); International Statistical Yearbooks 2015, https://stat.gov.pl/en/topics/statistical-yearbooks/statistical-yearbooks/international-statistics-yearbook-2015,11,3.html, (accessed 12 April 2018); The World Bank, http://data.worldbank.org/indicator/NY.GDP.MKTP.CD?view=chart, (accessed 12 April 2018).

TABLE 3. THE VALUES OF PEARSON'S LINEAR CORRELATION COEFFICIENTS FOR THE EXPLANATORY VARIABLES INCLUDED IN

	GDP	GDP per capita	Energy production	Exports of goods and services	Imports of goods and services	Industrial production growth rate	Inflation	Size of the grey economy
	X_1	X_2	X_4	X_{27}	X_{28}	X_{21}	X_{29}	X_{30}
X_1	1	0.96	0.93	-0.09	-0.39	-0.78	-0.12	-0.67
X_2	0.96	1	0.85	0.18	-0.12	-0.69	0.14	-0.84
X_4	0.93	0.85	1	-0.18	-0.47	-0.56	-0.15	-0.57
X_{27}	-0.09	0.18	-0.18	1	0.95	0.37	0.99	-0.68
X_{28}	-0.39	-0.12	-0.47	0.95	1	0.55	0.94	-0.42
X_{21}	-0.78	-0.69	-0.56	0.37	0.55	1	0.49	0.27
X_{29}	-0.12	0.14	-0.15	0.99	0.94	0.49	1	-0.65
X_{30}	-0.67	-0.84	-0.57	-0.68	-0.42	0.27	-0.65	1

Source: Own study.

Fig. 3. The result of a comparative analysis of the economic power of selected states. The calculations are based on an intuitive model

	Result
■ Poland	0,31
■ Germany	0,22
■ Czech Republic	0,33
■ Romania	0,13

Source: Own study.

In the second "intuitive" model, six out of the thirty-six potential descriptive variables were taken into account (Table 4). For the above subset of the descriptive variables, Pearson's linear correlation coefficients were calculated (Table 5). Figure 4 presents the values of the economic power of the compared states.

Table 4. The numerical values of the explanatory variables

	GDP X_1	Size of grey economy X_{30}	Current account of balance of payments X_{18}	Economic freedom index X_{25}	International investment position X_{13}	Inflation X_{29}
Poland	469,509	25	-1395	68.6	-62.8	1.8
Germany	3,466,757	13.5	289,159	73.8	48.7	1.8
Czech Republic	192,925	16.4	2139	72.5	-30.7	2.5
Romania	186,691	29.6	-4385	66.6	-51.9	1.4

Source: Foreign Trade Statistical Yearbook 2015–2016, https://stat.gov.pl, (accessed 12 April 2018); International Statistical Yearbooks 2015, https://stat.gov.pl/en/topics/statistical-yearbooks/statistical-yearbooks/international-statistics-yearbook-2015,11,3.html, (accessed 12 April 2018); The World Bank, http://data.worldbank.org/indicator/NY.GDP.MKTP.CD?view=chart, (accessed 12 April 2018).
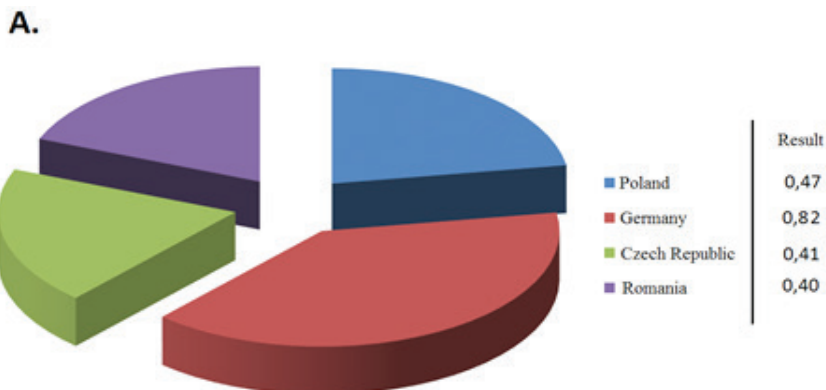
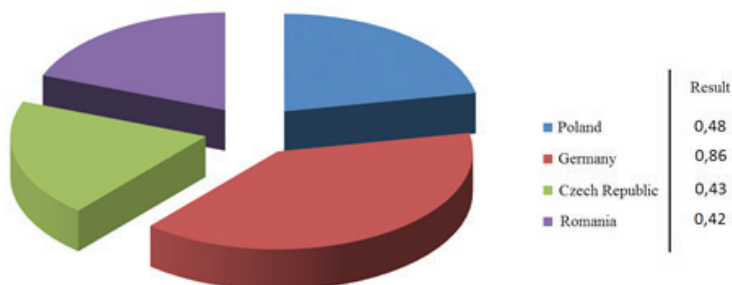|	GDP	Size of grey economy	Current account of balance of payments	Economic freedom index	Inter-national investment position	Inflation
	X_1	X_{30}	X_{18}	X_{25}	X_{13}	X_{29}
X_1	1	-0.67	1	0.67	0.94	-0.12
X_{30}	-0.67	1	-0.69	-1	-0.81	-0.65
X_{18}	1	-0.69	1	0.69	0.97	-0.09
X_{25}	0.67	-1	0.69	1	0.81	0.65
X_{13}	0.94	-0.81	0.97	0.81	1	0.09
X_{29}	-0.12	-0.65	-0.09	0.65	0.09	1

Source: Own study.

Figure 4A shows the result of a comparative analysis based on the assumption of the equal importance of all considered criteria, while Figure 4B presents the results with weights allocated to each criterion. The analysis of the results shows that the values of the ratings of the particular countries are convergent regardless of the type of the conducted analysis. Furthermore, in both cases, an almost identical result was achieved for the Czech Republic and Romania (the difference in assessment is only 0.01). Comparing the results obtained on the basis of both intuitive models, it should be stated that in both cases the results diverge from reality. At the same time, this clearly justifies negative assessments of "intuitive" models appearing in the literature.

Fig. 4. The result of a comparative analysis of the economic power of the selected states based on an intuitive model

	Result
Poland	0,47
Germany	0,82
Czech Republic	0,41
Romania	0,40

Source: Own study.

B.

	Result
■ Poland	0,48
■ Germany	0,86
■ Czech Republic	0,43
■ Romania	0,42

Source: Own study.

2.2. A sub-model of economic power – the authors' proposal

In order to select variables for a model of a state's economic power, Pearson's linear correlation coefficient was calculated for all thirty-six variables (Table 1) taken initially into account as explanatory variables. The results of the calculations are presented in Table 6.

The analysis of the results included in Table 6 showed that only three of the thirty-six variables could be used in a model of a state's economic power. These are the industrial production growth rate (x_{21}), the private sector credit flows (x_{15}), and the economic freedom index (x_{25}). The numerical values of the explanatory variables adopted in the model are presented in Table 7.

Table 6 (in 3 parts). Pearson's linear correlation coefficients for the explanatory variables included in Table 1

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}
X_1	1	0.96	0.90	0.93	0.99	0.66	0.13	0.95	0.99	0.96	0.81	0.95
X_2	-	1	0.98	0.85	0.94	0.84	-0.03	0.98	0.97	0.87	0.94	0.99
X_3	-	-	1	0.80	0.88	0.92	-0.18	0.98	0.92	0.81	0.98	0.99
X_4	-	-	-	1	0.97	0.57	-0.06	0.90	0.93	0.99	0.70	0.86
X_5	-	-	-	-	1	0.65	0.05	0.95	0.99	0.99	0.79	0.93
X_6	-	-	-	-	-	1	-0.49	0.85	0.69	0.55	0.98	0.87
X_7	-	-	-	-	-	-	1	-0.17	0.09	0.04	-0.32	-0.11
X_8	-	-	-	-	-	-	-	1	0.96	0.90	0.94	0.99
X_9	-	-	-	-	-	-	-	-	1	0.96	0.83	0.96
X_{10}	-	-	-	-	-	-	-	-	-	1	0.7	0.87
X_{11}	-	-	-	-	-	-	-	-	-	-	1	0.95
X_{12}	-	-	-	-	-	-	-	-	-	-	-	1

Source: Own study.

	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	X_{20}	X_{21}	X_{22}	X_{23}	X_{24}
X_1	0.04	0.67	-0.22	-0.09	-0.39	-0.12	-0.67	0.68	0.99	0.81	0.31	-0.43
X_2	0.26	0.84	-0.48	0.18	-0.12	0.14	-0.84	0.53	0.93	0.74	0.06	-0.61
X_3	0.43	0.92	-0.62	0.35	0.05	0.31	-0.92	0.38	0.87	0.71	-0.12	-0.73
X_4	0.10	0.57	-0.10	-0.18	-0.47	-0.15	-0.57	0.52	0.97	0.97	0.30	-0.46
X_5	0.07	0.65	-0.19	-0.11	-0.41	-0.12	-0.65	0.62	0.99	0.89	0.30	-0.46
X_6	0.73	0.99	-0.87	0.68	0.42	0.66	-0.99	0.01	0.62	0.55	-0.50	-0.91
X_7	-0.93	-0.46	0.64	-0.71	-0.65	-0.82	0.47	0.81	0.09	-0.30	0.85	0.80
X_8	0.35	0.85	-0.49	0.20	-0.11	0.19	-0.85	0.42	0.94	0.84	0	-0.69
X_9	0.08	0.70	-0.26	-0.05	-0.35	-0.08	-0.70	0.65	0.99	0.82	0.27	-0.46
X_{10}	0.02	0.55	-0.08	-0.22	-0.51	-0.21	-0.55	0.61	0.99	0.93	0.37	-0.40
X_{11}	0.57	0.98	-0.75	0.52	0.23	0.48	-0.98	0.22	0.77	0.64	-0.29	-0.83
X_{12}	0.33	0.87	-0.52	0.23	-0.08	0.20	-0.87	0.46	0.92	0.77	0	-0.67
X_{13}	1	0.72	-0.88	0.90	0.79	0.95	-0.72	-0.67	0.03	0.23	-0.92	-0.92
X_{14}	-	1	-0.87	0.68	0.42	0.65	-0.99	0.03	0.62	0.53	-0.48	-0.90
X_{15}	-	-	1	-0.95	-0.81	-0.92	0.87	0.37	-0.16	-0.10	0.82	0.87
X_{16}	-	-	-	1	0.95	0.99	-0.68	-0.61	-0.15	-0.10	-0.95	-0.76
X_{17}	-	-	-	-	1	0.94	-0.42	-0.74	-0.45	-0.40	-0.96	-0.55
X_{18}	-	-	-	-	-	1	-0.65	-0.70	-0.16	-0.10	-0.98	-0.81
X_{19}	-	-	-	-	-	-	1	-0.02	-0.62	-0.50	0.49	0.90
X_{20}	-	-	-	-	-	-	-	1	0.66	0.31	0.83	0.35
X_{21}	-	-	-	-	-	-	-	-	1	0.88	0.34	-0.42
X_{22}	-	-	-	-	-	-	-	-	-	1	0.17	-0.55
X_{23}	-	-	-	-	-	-	-	-	-	-	1	0.70
X_{24}	-	-	-	-	-	-	-	-	-	-	-	1

Source: Own study.

	X_{25}	X_{26}	X_{27}	X_{28}	X_{29}	X_{30}	X_{31}	X_{32}	X_{33}	X_{34}	X_{35}	X_{36}
X_1	-0.60	-0.26	0.94	0.09	0.61	-0.61	0.58	0.99	-0.42	0.46	-0.78	-0.57
X_2	-0.51	-0.47	0.99	-0.20	0.53	-0.78	0.78	0.97	-0.54	0.67	-0.69	-0.59
X_3	-0.38	-0.62	0.96	-0.30	0.53	-0.88	0.87	0.91	-0.65	0.79	-0.57	-0.64
X_4	-0.34	-0.29	0.78	0.13	0.85	-0.58	0.43	0.89	-0.56	0.41	-0.56	-0.78
X_5	-0.50	-0.29	0.90	0.09	0.72	-0.62	0.54	0.97	-0.49	0.46	-0.70	-0.67
X_6	-0.06	-0.86	0.80	-0.70	0.42	-0.99	0.98	0.68	-0.80	0.97	-0.25	-0.65
X_7	-0.84	0.86	0.10	0.81	-0.43	0.62	-0.43	0.17	0.84	-0.67	-0.70	0.66
X_8	-0.36	-0.55	0.94	-0.20	0.67	-0.83	0.77	0.94	-0.67	0.71	-0.58	-0.73
X_9	-0.57	-0.30	0.95	0.05	0.62	-0.64	0.61	0.99	-0.46	0.50	-0.76	-0.60
X_{10}	-0.44	-0.22	0.82	0.18	0.79	-0.54	0.43	0.93	-0.48	0.37	-0.65	-0.71
X_{11}	-0.25	-0.74	0.91	-0.50	0.47	-0.94	0.94	0.82	-0.72	0.89	-0.44	-0.64
X_{12}	-0.43	-0.53	0.97	-0.20	0.58	-0.82	0.81	0.95	-0.61	0.72	-0.63	-0.65
X_{13}	0.61	-0.97	0.17	-0.99	0.31	-0.81	0.72	0.03	-0.86	0.88	0.48	-0.60
X_{14}	-0.09	-0.85	0.81	-0.70	0.40	-0.98	0.99	0.69	-0.78	0.96	-0.27	-0.63
X_{15}	-0.21	0.91	-0.46	0.94	-0.06	0.87	-0.92	-0.26	0.69	-0.95	-0.11	0.38
X_{16}	0.42	-0.86	0.17	-0.99	-0.11	-0.70	0.75	-0.06	-0.59	0.82	0.37	-0.23
X_{17}	0.53	-0.69	-0.12	-0.90	-0.34	-0.45	0.52	-0.35	-0.38	0.61	0.55	0.01
X_{18}	0.56	-0.90	0.09	-0.99	0	-0.71	0.71	-0.10	-0.68	0.82	0.49	-0.34
X_{19}	0.09	0.85	-0.81	0.68	-0.41	0.98	-0.98	-0.69	0.78	-0.96	0.27	0.63
X_{20}	-0.95	0.50	0.61	0.68	0.07	0.11	-0.01	0.70	0.37	-0.25	-0.96	0.13
X_{21}	-0.53	-0.24	0.90	0.14	0.70	-0.58	0.51	0.97	-0.45	0.42	-0.73	-0.64
X_{22}	-0.09	-0.39	0.63	0.04	0.96	-0.60	0.38	0.76	-0.69	0.44	-0.34	-0.90
X_{23}	-0.69	0.82	0.11	0.97	0.06	0.56	-0.54	0.30	0.60	-0.70	-0.65	0.25
X_{24}	-0.34	0.98	-0.51	0.81	-0.54	0.97	-0.86	-0.41	0.96	-0.97	-0.14	0.79
X_{25}	1	-0.45	-0.62	-0.50	0.18	-0.09	-0.11	-0.64	-0.45	0.17	0.97	-0.31
X_{26}	-	1	-0.38	0.91	-0.41	0.92	-0.83	-0.25	0.92	-0.96	-0.28	0.69
X_{27}	-	-	1	-0.10	0.39	-0.71	0.77	0.97	-0.42	0.62	-0.78	-0.45
X_{28}	-	-	-	1	-0.01	0.72	-0.73	0.07	0.68	-0.84	-0.45	0.34
X_{29}	-	-	-	-	1	-0.52	0.24	0.54	-0.74	0.37	-0.06	-0.94
X_{30}	-	-	-	-	-	1	-0.95	-0.61	0.89	-0.98	0.11	0.74
X_{31}	-	-	-	-	-	-	1	0.61	-0.70	0.96	-0.25	-0.49
X_{32}	-	-	-	-	-	-	-	1	-0.38	0.47	-0.81	-0.51
X_{33}	-	-	-	-	-	-	-	-	1	-0.86	-0.22	0.92
X_{34}	-	-	-	-	-	-	-	-	-	1	0	-0.64
X_{35}	-	-	-	-	-	-	-	-	-	-	1	-0.06
X_{36}	-	-	-	-	-	-	-	-	-	-	-	1

Source: Own study.

Table 7. The numerical values of the explanatory variables

	Industrial production growth rate X_{21}	Private sector credit flows X_{15}	Economic freedom index X_{25}
Poland	4.9	3.1	68.6
Germany	1.5	3	73.8
Czech Republic	4.6	0.9	72.5
Romania	2.8	0.2	66.6

Source: Own study.

Table 8 shows Pearson's linear correlation coefficients for the explanatory variables adopted in the model.

Table 8. The values of Pearson's linear correlation coefficients

	Industrial production growth rate X_{21}	Private sector credit flows X_{15}	Economic freedom index X_{25}
X_{21}	1	-0.06	-0.27
X_{15}	-0.06	1	0.40
X_{25}	-0.27	0.40	1

Source: Own study.

Figure 5. A comparative analysis of the growth of the economic power of the compared states

Source: Own study.

Figure 5 presents the results of comparative analysis. The numerical values of the achieved results indicate a better representation of reality compared to the results obtained from the "intuitive" models.

Simultaneously, it should be noted that one of the variables taken into account describes the dynamics of changes (variable x_{21} – industrial production growth rate), i.e. it refers to the values from the previous period, while the other variables are static. In view of the above, this was the reason for the appropriate allocation of weights to the individual assessment criteria in the presented model of the economic power of states.

The comparative analysis carried out demonstrates that the greatest increase in the economic power in the analysed period took place in Germany (0.68). Slightly smaller growth was recorded in the Czech Republic (0.62) and Poland (0.60), while the lowest value of increase was in Romania (0.23). The conducted qualitative comparative analysis of the economic power of selected European countries allowed to conclude that the independent variables identified are crucial for the formation of the economic power of the analysed countries. At the same time, a fairly strong position of the Czech Republic and Poland in relation to the economic power of Germany was found. The performed quantification of the economic power of the European countries provides a basis for the correct determination of changes in the power distribution of political units, assessment of the power and resources held by the state.

CONCLUSIONS

In the opinion of the authors, in the research on the power of a state conducted so far there is definitely no detailed analysis of power-creating factors within the particular functional sectors of a state. This is mainly due to the existing deficit of partial meters determining the quantitative nature of individual components constituting the power of an entity undergoing examination, which in consequence translates into a small number of analytical models in this respect (as opposed to synthetic models). In consequence of the above, conducted scientific analyses are significantly "flattened" and mainly limited to the descriptive sphere of phenomena, will little attention paid to the structure of detailed quantitative sub-models.

Hence the direction of scientific research undertaken by the authors, which aims to bridge gradually the existing research gap. The research

carried out within the range of this paper allows the authors to conclude that in the diversity of descriptive variables in the economic sphere there is a subset of variables that are mutually independent and at the same time strongly correlated with the power of a state, which makes it possible to implement a verifiable model of the studied phenomenon. The final effect of the performed analysis is the development of the authors' original sub-model of the economic power of a state. It should be emphasized that the explanatory variables adopted by the authors in the economic area do not constitute a closed catalogue. On the contrary, the authors see the need to extend and broaden the exploration of indicators determining the power of a state in this area. The presented results of the comparative analysis of the economic power of the selected states based on statistical methods constitute the first stage of the authors' work on the quantification of power-creating factors. We hope that this paper will contribute to the popularization of the presented research approach.

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